Metal Finishing

POLISHING AND BUFFING · BARREL FINISHING · CLEANING
PLATING · ANODIZING · RUST PROOFING · LACQUERING & ENAMELING

APRIL, 1961

CONTENTS:

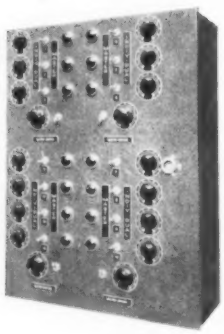
Read and pass on—

PLATING POWER BY DC POWER SPECIALISTS

Mathematical Design from Scripta Mathematica

SPECIALIZATION

is a big word at RAPID ELECTRIC



Because we at RAPID specialize in dc power supplies and their controls *you* get an entire line of standard models to choose from, plus the individual attention you require for custom requirements.

No one knows better than we, that power requirements and controls vary to individual processes. That's why we at RAPID provide a full range of controls, from standard tap switch to automatically stabilized units—*programmed* to your needs.

Before you buy your next rectifier why not consult with your local RAPID distributor (name available upon request) you'll find you'll save time and money by purchasing the right equipment for your needs.

RAPID ELECTRIC CO., INC.

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PLANTS: (4) NEW YORK, N.Y. • GRAYSBRIDGE ROAD, BROOKFIELD, CONN.

Stay out front with these new products

of *Enthonics** research

BLACKENING: Ebonol® Additive "S" — Eliminates red smut when blackening steel.

METAL STRIPPING: Enstrip® S-60 — Low cost, water soluble powder strips nickel rapidly at room temperatures.

ELECTRO-CLEANING: Cleaner 808 — The electro-cleaner for steel that removes light smut, scale, oxides and soil through chelating action.

PAINT STRIPPING: Stripper S-26 — Chlorinated stripper dilutable with water, used at room temperature; strips epoxies and other baked synthetics.

STEEL CLEANING: Endox® — One-step process for preparing steel for plating without use of acids. Removes rust, scale and smut.

TARNISH PREVENTION: Entek® CU-56 — Added to rinse water, it produces an invisible film that prevents tarnishing.

PLATING ON ALUMINUM: Alumon® "D" — A dilute zincate solution for trouble-free plating results.

SPRAY WASHING: Sprean 66 — Non-foaming, powdered detergent removes light oils, drawing compounds.

STEAM CLEANING: Enfroth — A concentrate for steam cleaning, removes all grease, heavy dirt, oils.

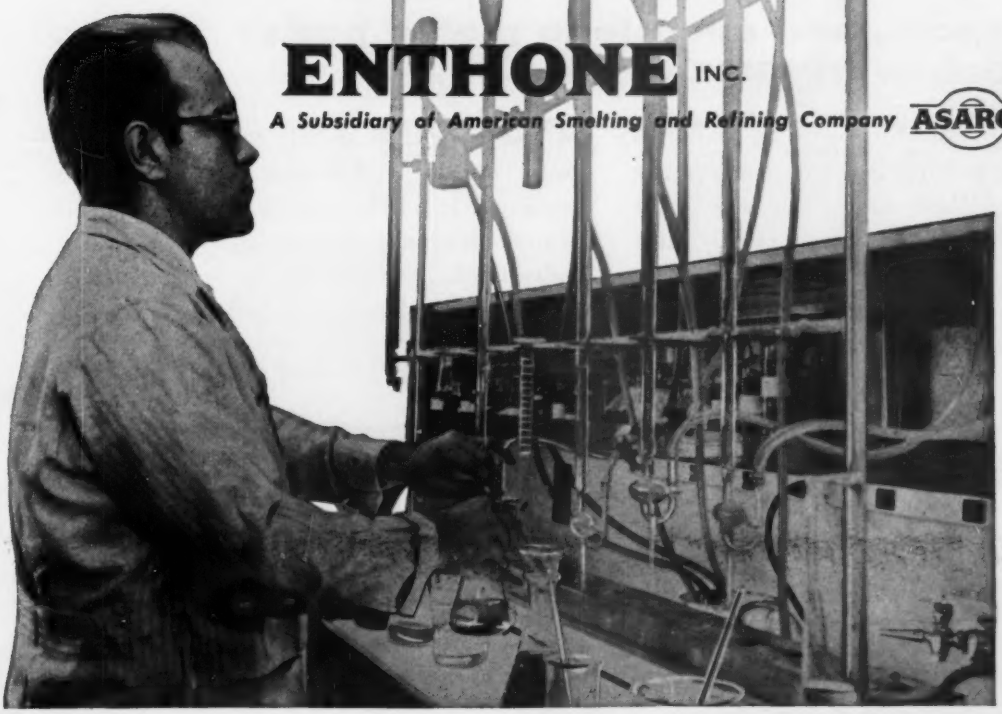
PRINTED CIRCUIT PROCESSING: Cut rejects with complete line of chemicals for printed circuit processing; cleaners, activators, electroless plating baths, Stripper "K" for removing photo resist.

For your copy of brochure describing methods and materials to speed production, cut costs and produce better finished products, write to: Enthone, Inc., 442 Elm Street, New Haven 8, Conn.

*The scientific solution of metal finishing problems.

ENTHONE INC.

A Subsidiary of American Smelting and Refining Company ASARCO



APPLIED ENTHONICS®

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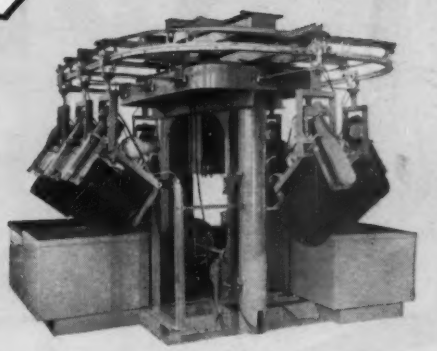
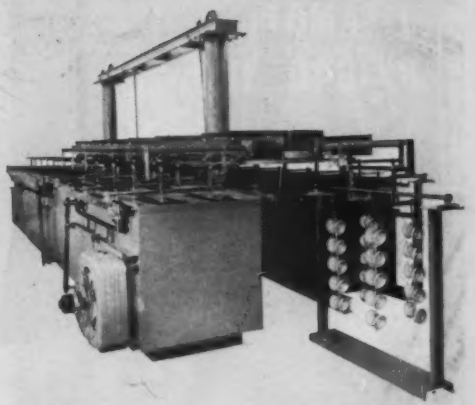
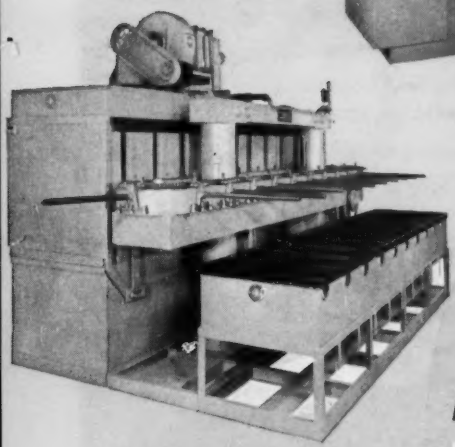
CROWN AUTOMATICS



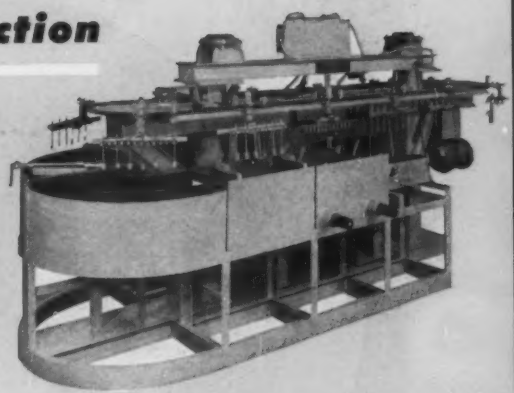


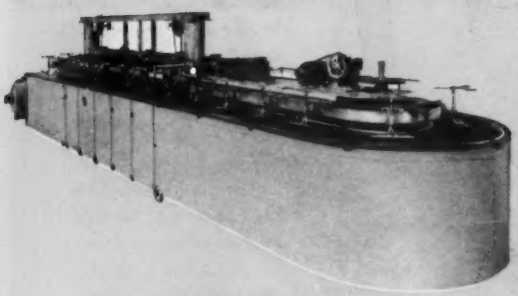


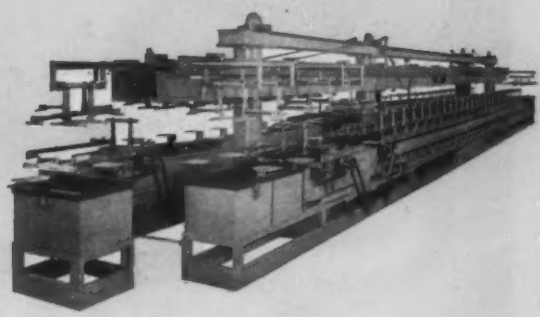
increase production

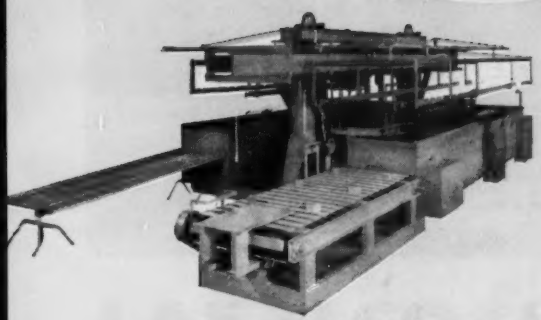
reduce costs

improve quality









Crown Automatics are ideal for plating your barrel or racked work. Crown manufactures the widest variety of fully automatic plating machines in the industry... *there is a model to fit your needs.* Write us details of your job and production requirements.

CROWN RHEOSTAT AND SUPPLY COMPANY

1965 PRATT BOULEVARD • ELK GROVE VILLAGE ILLINOIS

When stacked end-to-end in 30 gallon drums, that's over 25 times as high as the Empire State Building.

That's a lot of nickel!

One half million gallons can't be wrong. One half million gallons is doing a job and doing it right! One half million gallons of proven reliability.

When you talk Sulfamate Nickel—you talk Barrett—for experience, know how, and proven reliability have made Barrett and sulfamate technology synonymous.

BARRETT SULFAMATE NICKEL — a "ready-to-operate" process for high speed electrodeposition of nickel having exceptionally low tensile stress.

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FULLY AUTOMATIC PLATING MACHINE

(Furnished For Rack Or Finger Type Plating)

Unloads Automatically Only plating machine in the industry that unloads racks or fingers without operator's attention.

Selective Cycling Automatic by-passing of tanks—or any combination of cycles—can be arranged on the Daw Jr.

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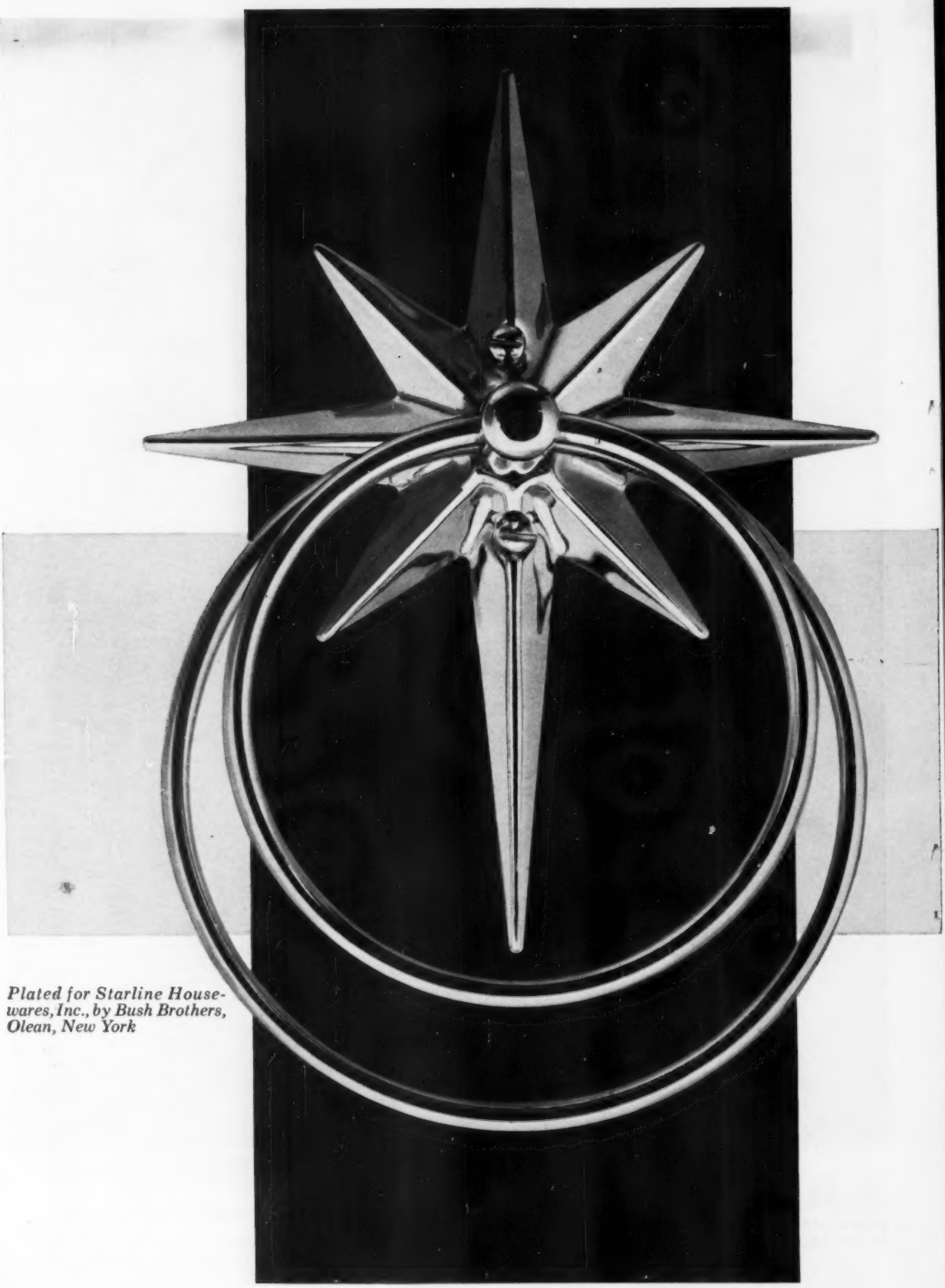
ATTACH TO COMPANY LETTERHEAD

Send complete information on Daw Jr. Automatic Plating Machine

Name.....

Title.....



Plated for Starline Housewares, Inc., by Bush Brothers, Olean, New York

Gumm's twenty-eighth year of research and service is, as always, devoted to the single job of developing and improving CLEPO Products supplied to the Metal Finishing Industry. It is not surprising that we are continuously called upon, as specialists, to 'prescribe' for barrel finishing operations.

The resources represented by this entirely specialized experience are in two major categories: compound, *and* media for barrel finishing. This sound marriage of products undoubtedly accounts for our constant activity in prescribing 'by the barrel'.

Gumm's barrel tumbling pilot plant, research and development laboratory, testing and semi-production laboratory, are always available to *you*. If you want the advantages of the specialist's 'prescription', write or call

FREDERICK GUMM CHEMICAL COMPANY, INC.
538 FOREST STREET, KEARNY, NEW JERSEY

RELIABILITY
is old hat at STEVENS!

That's right! "Reliability" is not a new word at Stevens. It's been a watchword in product research, development and application for more than 75 years. And it will be an area of increasing concentration in the future. ■ From gleaming household appliances to automobiles that stay bright-as-new for years, Stevens continues to provide the metal-finishing know-how that gives you the highest possible reliability factor within the required limits of your cost structure. ■ Stevens Liquid Buffing and Polishing Compositions, for example, illustrate what we mean. Whether you require a heavy cut or extremely high color, there's a job-matched formula that performs better, faster, more efficiently. And, when you start with a superior buffed or polished surface on castings, stampings or machined parts, you've taken an important step toward the ultimate reliability of the final plating. ■ In a great many areas of metal processing and finishing, Stevens places valuable experience at your service to help achieve the higher reliability that buyers expect of your products.

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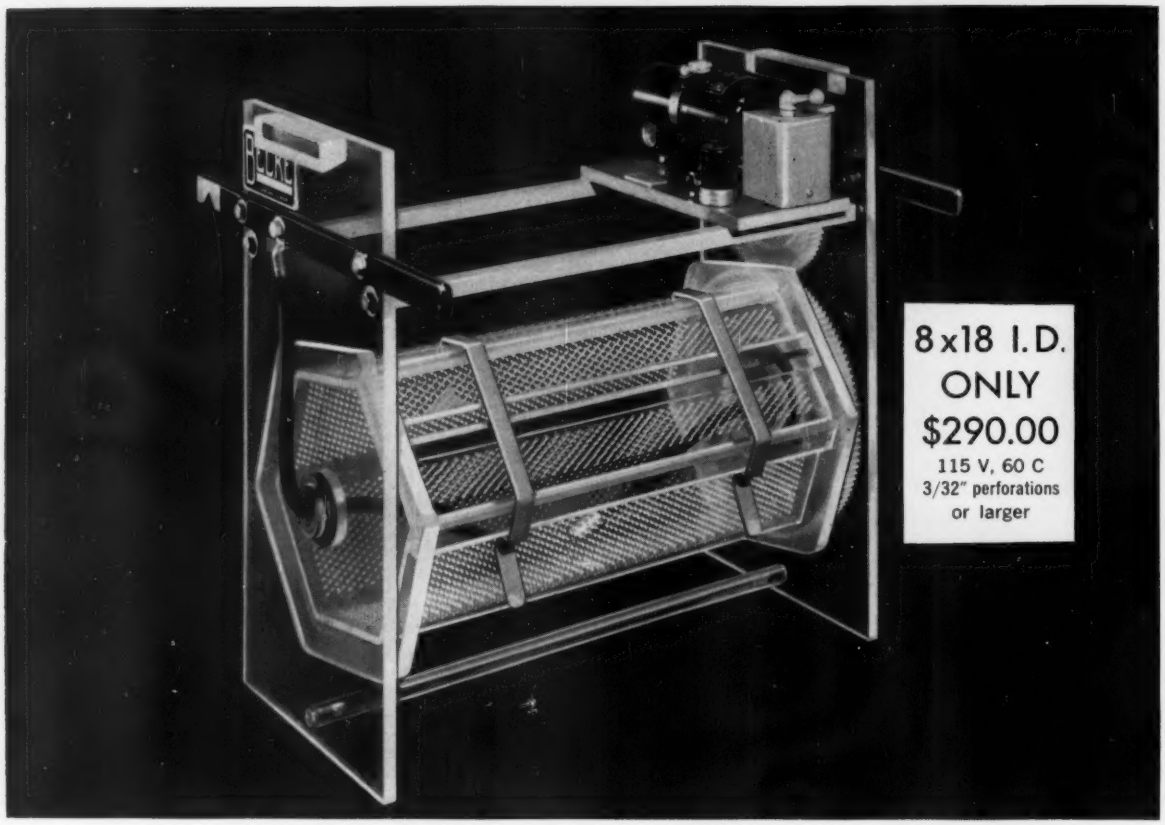

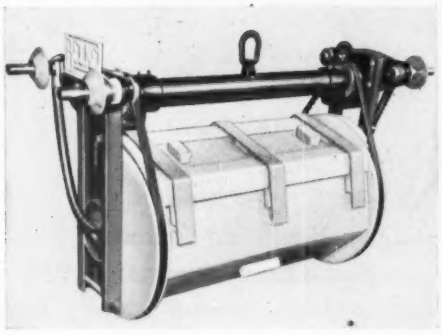

BELKE Quick Belt Change Hanger with polypropylene cylinder designed to withstand cleaning and plating cycles up to 200F

Send for literature.

A Tremendous Bargain in Low Cost Plating Capacity!

Consider the added plating efficiency and capacity this 8x18 barrel brings you at low cost.

You can operate this barrel in still plating tanks; you get extra plating capacity when needed with no added investment in tanks or space. You can set this barrel aside quickly and have all the tank capacity for still plating when needed.

You can plate intermediate size loads at low cost and avoid tying up regular barrel production.

You can handle hard-to-plate jobs at low cost; again without disrupting your regular barrels.

The BELKE 8x18 is quality built throughout. The V-notched copper arms make positive contact any place on the cathode rod. One piece flexible cables assure full volume plating current. High temperature Plexiglas construction withstands cleaning and plating cycles.

Send for literature.

Belke MANUFACTURING COMPANY
947 N. Cicero, Chicago 51

EVERYTHING FOR PLATING PLANTS

STONE AGE or JET AGE

how does your chrome plating stack up?

You can keep your chrome-plating process in step with today — with Diamond CPA 1800®.

For example: The CPA 1800 process is now being used in advanced jet engine experimentation — meeting the severest tests for corrosion and abrasion-resistance tolerances ever imposed on high-pressure seals.

This same jet-proven additive is available to you and to your chrome-plate source. To increase plating speed and covering power. To allow a broader operating range. To simplify anoding and produce a brighter, harder coating. To improve the metallurgical characteristics of chromium plate.

In short: Diamond CPA 1800 can cut your unit costs and save you money. Diamond developed it. Your Diamond CPA 1800 Distributor can supply it where and when you need it. For further information write or call Diamond Alkali Company, 300 Union Commerce Building, Cleveland 14, Ohio.

Diamond Chemicals

DIAL TABLE—built to fit your exact requirements.

#55 HEAD—compact, rugged, multi-position polishing and buffing head. Operates right or left.

VERSATILE "PRODUCTION-PROVEN" FINISHING EQUIPMENT *from* MURRAY-WAY

INDEXING CONVEYOR—incorporates exclusive Murray-Way indexing or continuous features.

EDGE GRINDER—for precision grinding of products such as floor tile.

Murray-Way offers a complete line of standardized, economical finishing equipment for both large and small shops. In addition, experienced Murray-Way production engineers, working with the finest manufacturing facilities available, will gladly help with your specialized production problems.

Write for detailed literature.

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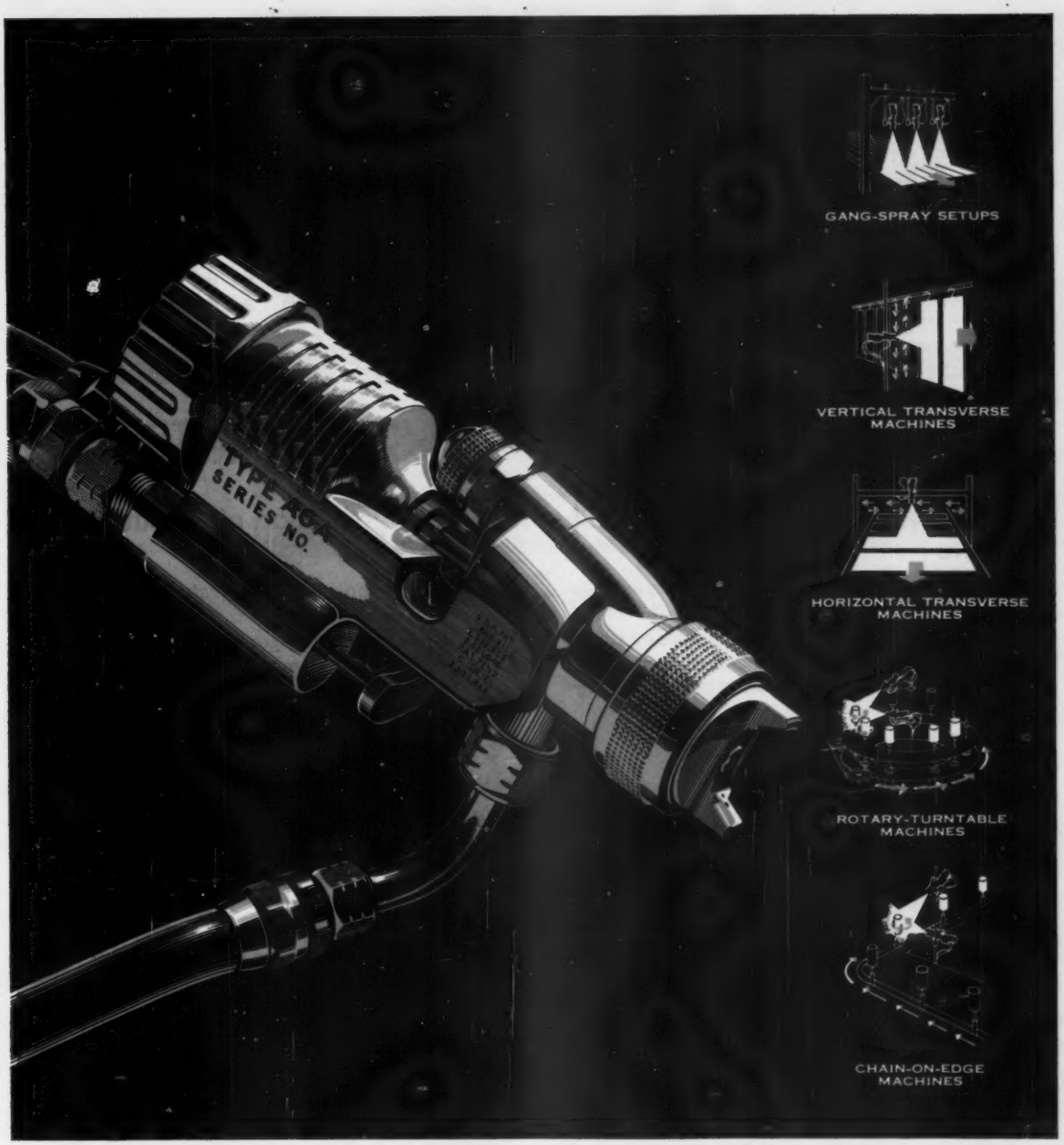
BIRMINGHAM, MICH.



automatic spray from DeVilbiss gives you control and uniformity not possible by other methods for applying paints, adhesives, glazes; marking, stenciling. It's part of a complete line of matched equipment for coating and finishing: spray guns, dip and flow coaters, spray booths, air and fluid hose, ovens, spray washers, air-replacement units, dust collectors, "turn-key" finishing systems.

Talk to DeVilbiss about all your automatic spray-coating needs

FOR TOTAL SERVICE, CALL
DEVILBISS

THE DeVILBISS COMPANY, Toledo 1, Ohio. Also Barrie, Ontario; London, England; São Paulo, Brazil. Branch offices in principal cities.

6 WAYS TO SAVE MONEY
IN YOUR DEGREASING OPERATION

...from the makers of COLUMBIA-SOUTHERN TRICHLOR

1. Keep your solvent in the machine

Your solvent can't clean much metal when it's floating around in the air. Prevent drafts which remove solvent. Check open doors, windows and location of fans. Keep cover on unit during idle periods—solvent evaporates whether it's hot or cold.

2. Don't waste heat

By keeping your heating and condensing coils clean, you can operate your equipment at the design rate and thus control resultant waste of solvent and heat. Make sure the thermostats are kept clean and functioning properly.

3. Make sure your solvent is formulated for the job

Columbia-Southern Trichlor contains a special neutral stabilizer which enables it to stand up under continuous operation with high contamination rates. Trichlor's stabilizing system is designed specifically to permit you to handle aluminum as well as other metals safely in the degreaser.

4. Establish good cleanout procedures

Keep an eye on sump temperatures, and distill in time to avoid excessive contamination and low heat transfer. You not only get more efficient operation, but you may also save your equipment and reduce operating costs.

5. Protect equipment investment with scheduled maintenance

Schedule routine maintenance on valves, pumps, piping, gaskets and water separator; regular attention to little items prevents emergency repairs to the whole system.

6. Keep down dragout losses

Handle and rack your work properly. We often find that the type, shape and weight of parts going through machines are not given proper consideration. Liquid solvent may be trapped or vapor levels dropped as a result. A review of these factors, plus location of sprays, and throughput speed can reduce waste by a healthy figure.

These simple but effective rules have been developed by the Technical Service group at PPG's Chemical Division, as a result of hundreds of service calls and years of experience in applying Columbia-Southern TRICHLOR to degreasing operations.

Trichlor is built for the job, starting with a "triple-check" quality control system during manufacture. The stability, uniformity and purity of Trichlor are guarded by the blending in of carefully compounded *neutral* stabilizing agents which maintain the solvent in a safe, effective state through the toughest service.

Save money in your vapor degreasing operation by following the six rules above and specifying Columbia-Southern Trichlor. Call your nearby Trichlor distributor or the Columbia-Southern office serving your area.

columbia | southern chemicals
CHEMICAL DIVISION
PITTSBURGH PLATE GLASS COMPANY
ONE GATEWAY CENTER PITTSBURGH 22, PENNSYLVANIA
DISTRICT OFFICES: Boston • Charlotte • Chicago • Cincinnati • Cleveland Dallas • Houston • Minneapolis • New Orleans • New York • Philadelphia Pittsburgh • San Francisco • St. Louis • IN CANADA: Standard Chemical Limited

METAL FINISHING'S UNCHALLENGED COVERAGE OF ORGANIC FINISHING BRINGS LARGE NUMBER OF DIRECT INQUIRIES

So states John L. Armitage, president of the John L. Armitage Company, Newark, N. J., manufacturers of industrial product finishes — lacquers, enamels, vinyls, etc.

This firm was founded in 1876 by John L. Armitage's grandfather and sells on a nationwide basis to manufacturers of mainly metal products, some plastics and other non-metallics. Armorhide®, Armorsol®, and Armorette are its popular vinyl finishes.

Mr. Armitage has read METAL FINISHING since 1945 and advertised in it since 1957. He considers our technical articles to be the most authoritative in the field and believes they are geared to the interests of his type of customer.

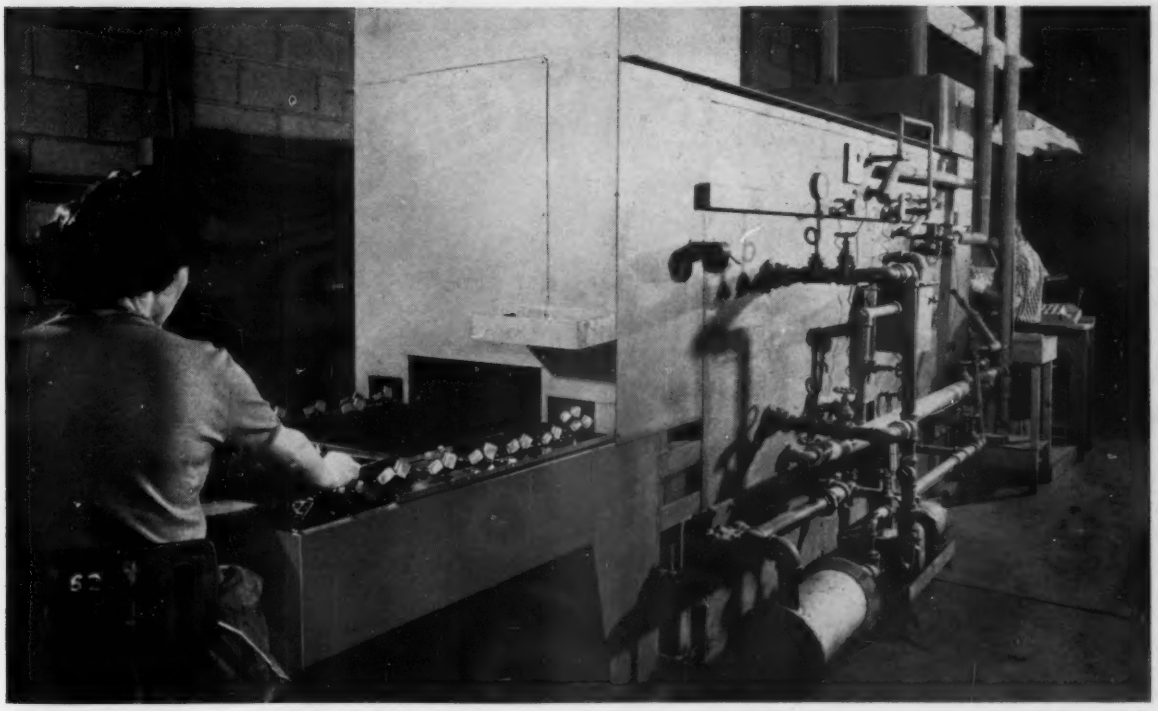
Mr. Armitage approves the paid circulation policy of METAL FINISHING—$5 per year in the United States and Canada and $15 in other countries.

If you sell similar industrial coating materials, product finishes, organosols and plastisols, or the equipment for applying them, you too, can profit by a regular advertising program in METAL FINISHING, the technical authority of this industry since 1903. Write for AIA data file, distributors list, and county breakdown of our mailing list of firms operating finishing departments.

59 YEARS

METAL FINISHING

381 Broadway, Westwood, New Jersey



HOW ZIPPO DEGREASES 100,000 PARTS BEFORE CLEANOUT

Zippo Manufacturing Company, Bradford, Pa., is meticulous about degreasing parts and cases used in their lighters. The company does as careful a cleaning job as watchmakers or manufacturers of aircraft instruments.

With all their attention to detail, they still manage to degrease 100,000 parts before cleanout with Nialk® TRICHLORETHYLENE. The special stabilizer contains *psp*—permanent staying power. This permits them to process a large volume of parts without endangering their quality. *Psp* maintains the stabilizer at maximum efficiency between cleanouts.

The stabilizer also prevents gummy substances from forming, substances which might coat the heating elements in the degreaser units and reduce efficiency of the operation. The vapor and bath stay clean. Parts never become tarnished.

When baths are cleaned out, Zippo gets full recovery of the solvent, and it is fully stabilized so they never have the cost and trouble of adding fresh stabilizer to maintain bath strength.

Zippo likes the several different degreasing jobs that Nialk TRICHLOR does. As many as five different metals might be degreased in a day—brass, stainless steel, die-cast zinc, copper and gold.

Even considering all the use Zippo gets from each bath, they have never had to sacrifice quality. There has never been a need to titrate or run any other type of test.

Nialk TRICHLOR can bring you the same benefits and cost savings. Hooker technical experts can help you to set up your degreasing operations, then check regularly to make sure your operation remains trouble-free. Zippo obtains Nialk TRICHLOR through Ken C. Merrill Co.

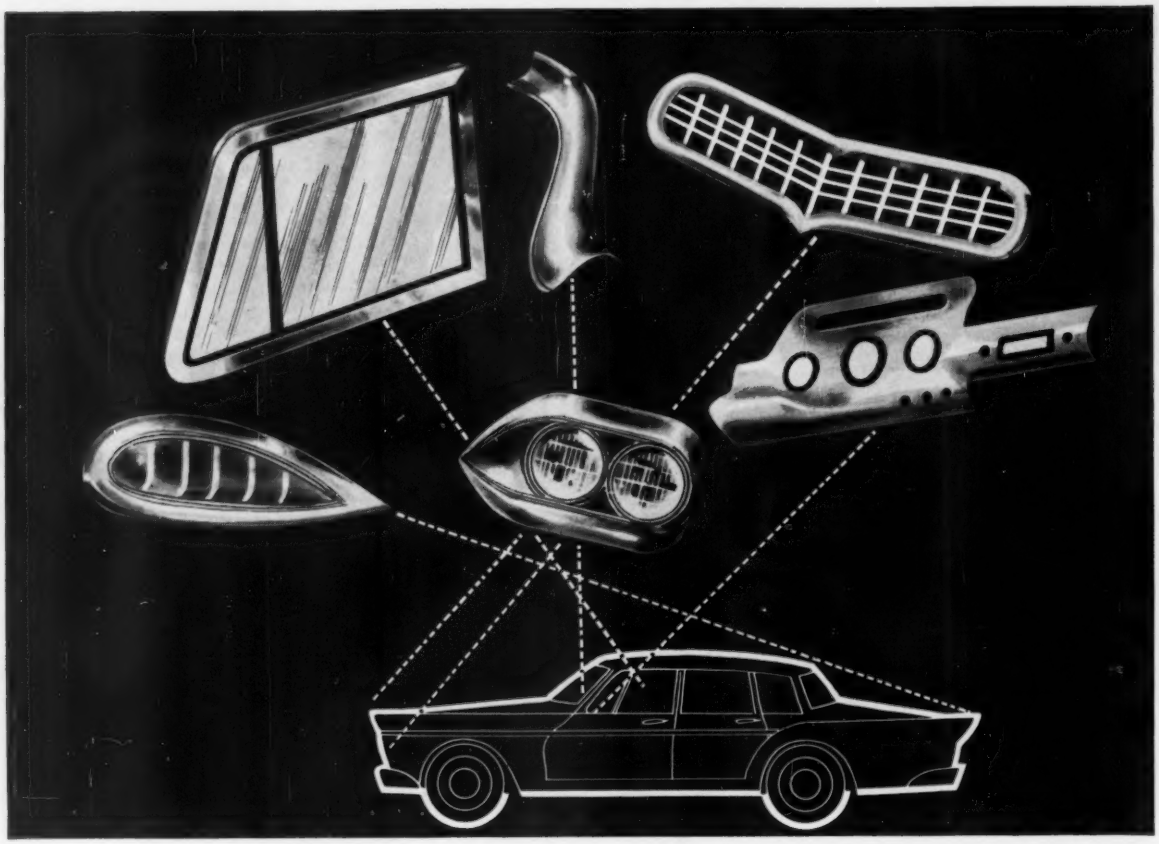
See *your* Hooker Chemical distributor. He will be glad to help you with your problems and questions. Or write us direct. Our years of experience are yours for the asking.

HOOKER CHEMICAL CORPORATION

1304 UNION STREET, NIAGARA FALLS, NEW YORK

HOOKER CHEMICALS PLASTICS

Sales offices: Buffalo, Chicago, Detroit, Los Angeles, New York, Niagara Falls, Philadelphia, Tacoma, Worcester, Mass. *In Canada:* Hooker Chemicals Limited, North Vancouver, B.C.



Aluminum adds the bright touch

"Bright dip" aluminum parts and trim bring a high note of glamour to the graceful lines of modern automobiles. Practical, easily-formed aluminum appears as mirror-bright radiator grilles, body trim, window molding, light bezels, and a growing list of other parts.

"Bright dipping" is a chemical polishing process that dissolves the microscopic high points of a metal's surface faster than its low points. Thus, a few minutes' dip in the solution smoothes and thereby polishes aluminum parts to a high lustre. Then they are anodized for protection against wear and corrosion. This unique polishing process—also used with copper, brass and stainless steel—is becoming part of the manufacture of a long list of products extending from automobiles to zippers.

The major ingredient in "bright dip" solutions is phosphoric acid, one of the many phosphorus chemicals produced by Virginia-Carolina Chemical Corporation. V-C Phosphoric Acid, made from elemental phosphorus from V-C's own phosphate mines, is known for outstanding quality and purity. All three grades exceed American Chemical Society, National Formulary, and Food and Drug Regulations requirements where applicable.

V-C Phosphoric Acid	85% N.F. Grade	80% Food Grade	75% Food Grade
Sp. Gr. (20°/4°C)	1.691	1.635	1.581
Lbs./gal.	14.1	13.6	13.2
P_2O_5	61.71%	58.08%	54.50%
H_3PO_4	85.21%	80.20%	75.26%
Cl	0.0001%	0.0001%	0.0001%
Fe	0.0002%	0.0002%	0.0002%
Pb	0%	0%	0%
As_2O_3	0%	0%	0%

FREE BOOKLET "Bright Dip Hints" and samples available. V-C specialists, drawing on years of "bright dip" experience, are happy to give you detailed information in terms of your own operation. Write today!

Virginia-Carolina Chemical Corporation • Chemicals Division
401 East Main Street, Richmond 8, Virginia • Phone: Milton 8-0113

V-C® **Phosphoric Acid**

THE FASTEST . . .

CLOSE-COUPLED FOR QUICK-ACTION!

Singleton Offers Top-Performing Barrel in Plating
Converts All Makes to Belt-Drive and Inverted-V Contacts

Better, faster barrel plating is easy to "claim." But, Singleton backs it with **facts**. A thru-cycle time study on the new Singleton "Low-Boy" in your own plant will give you **proof!** Here's the barrel that streamlines your production.

Only "Low-Boy" Has These Features:

Lowest Overall Height. "Low-Boy" is 2" to 7" shorter from bottom of cylinder to top of attaching U-bolt than any other make. Only 30½" overall.

Lowest In-Tank Silhouette. "Low-Boy" extends only 7½" above tank for faster, safer barrel movements overhead.

Lower Head-Room Required. "Low-Boy" moves easily, safely in restricted overhead areas where other makes won't clear.

Shorter, Quicker Hoisting. "Low-Boy" saves important hoist-time and manhours. Saves up to 18" hoisting per station—they add up.

Shorter Drive-Belts. "Low-Boy" is closer-coupled between cylinder and drive-pulleys. Shorter belts cost less.

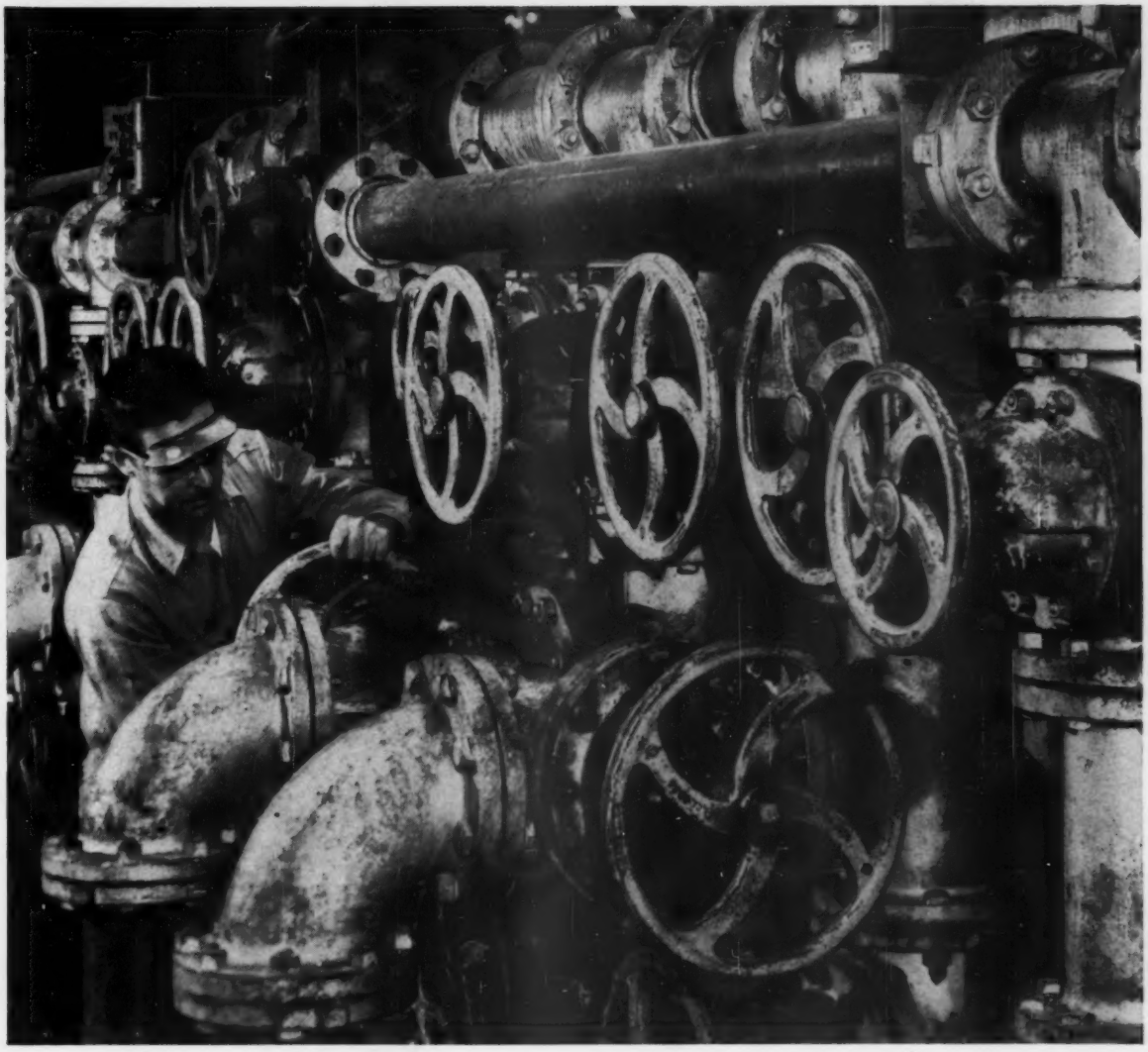
Cylinder Entirely Submerged. "Low-Boy" shortened height above tank only. Total cylinder submersion prevents gas pockets, explosions, etc.

Converts All Makes to Belt-Drive, Inverted-V Contacts. "Low-Boy" is first and only superstructure to adapt your existing equipment to these modern improvements.

With 14 years leadership in plating barrel development, Singleton continues to offer the most complete line of equipment in the industry. **Singleton Replacement Cylinders** to fit all makes, types, sizes, ages of superstructures. **Singleton Cylinder-Superstructure Units** to fit existing installations—any make, type, size, age. **Singleton "Cogged-V-Belt" Drive (or gear) Plating Barrels,** single or multi-station, allied equipment and accessories. These and others are featured in the new Singleton General Bulletin. Includes data, prices, etc. Send for it.

Singleton

Please contact **The Singleton Co.**, 11720 Berea Rd., Cleveland 11, Ohio.
Telephone: CLearwater 1-5580.



SARAN LINED PIPE—only one short length replaced after 8 years and 500,000,000 acid gallons

These Saran Lined Pipes and valves have carried 8300 gal./hour of hot acid plating solution . . . 24 hours per day, six days per week, for eight years. If they fail, the cost of production downtime is $11,000 *per hour*. In the entire 400-foot line, only two valves and a ten-foot length of pipe have been replaced in the eight years!

This piping complex feeds acidic solutions from heat exchangers to plating tanks in a large automotive plant. The solutions are circulated day and night, keeping the tanks at a required 160° F. A break in the line could also cause complete loss of the tanks' contents—at a cost of $8000, not counting downtime.

At the time of installation, many types of corrosion-resistant pipe were tested. Saran Lined Pipe was chosen as the permanent transfer medium for this operation for several reasons: extreme resistance to corrosion . . . high strength, requiring minimum support for horizontal runs . . . easy cutting and fitting without special equipment.

Whenever dependable piping systems are needed for corrosive material, consider Saran Lined Pipe. Saran Lined Pipe, valves, fittings and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200° F. They can easily be cut, fitted and modified in the field without special equipment. For more information, write Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale, Michigan, Dept. 1567CF4.

THE DOW CHEMICAL COMPANY DOW Midland, Michigan

THE NEW STUTZ PORTABLE Plating Barrel *with* CONE BUTTON CONTACTS

Offered for the first time, a Portable Plating Barrel with Cone Button Contacts. This type contact produces a perfect plating job on small delicate parts without distorting the parts. Barrel is of loose rib and panel design for easy replacement of parts, when necessary.

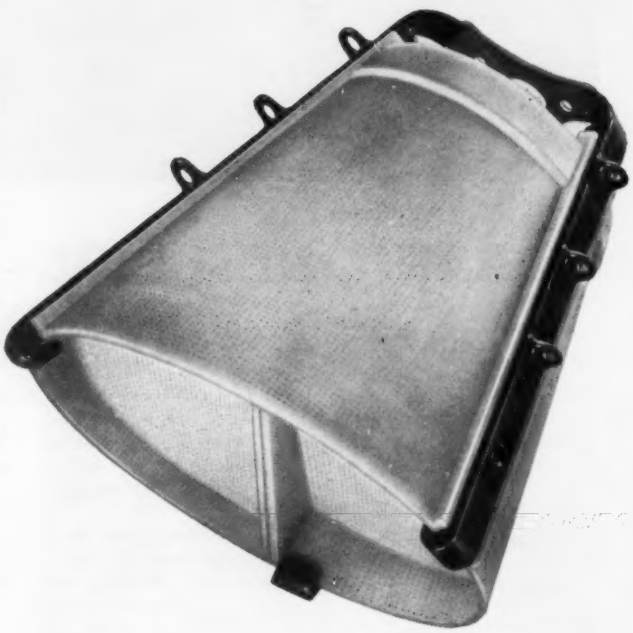
Units available in high temperature Plexiglas in either 6″ x 12″ I.D. or 8″ x 18″ I.D. sizes. Also special sizes upon request. Standard perforations are 3/32″, smaller or larger openings are available.

Stutz, the leader in Barrel Plating Equipment both in design and construction — presents an entirely new barrel for use on the tub type automatic barrel plating machine.

The Stutz Barrel is constructed of high impact Polypropylene and welded into a solid unit. This resin is virtually indestructible and can be safely used in all solutions and temperatures.

Maximum perforations are provided and these are carried into the bottom skirt. Solution dragout therefore is reduced to the least possible amount and plating speed is exceptionally good.

Every user of this new barrel will testify that it is the finest contribution made in the operation of the tub type machine.



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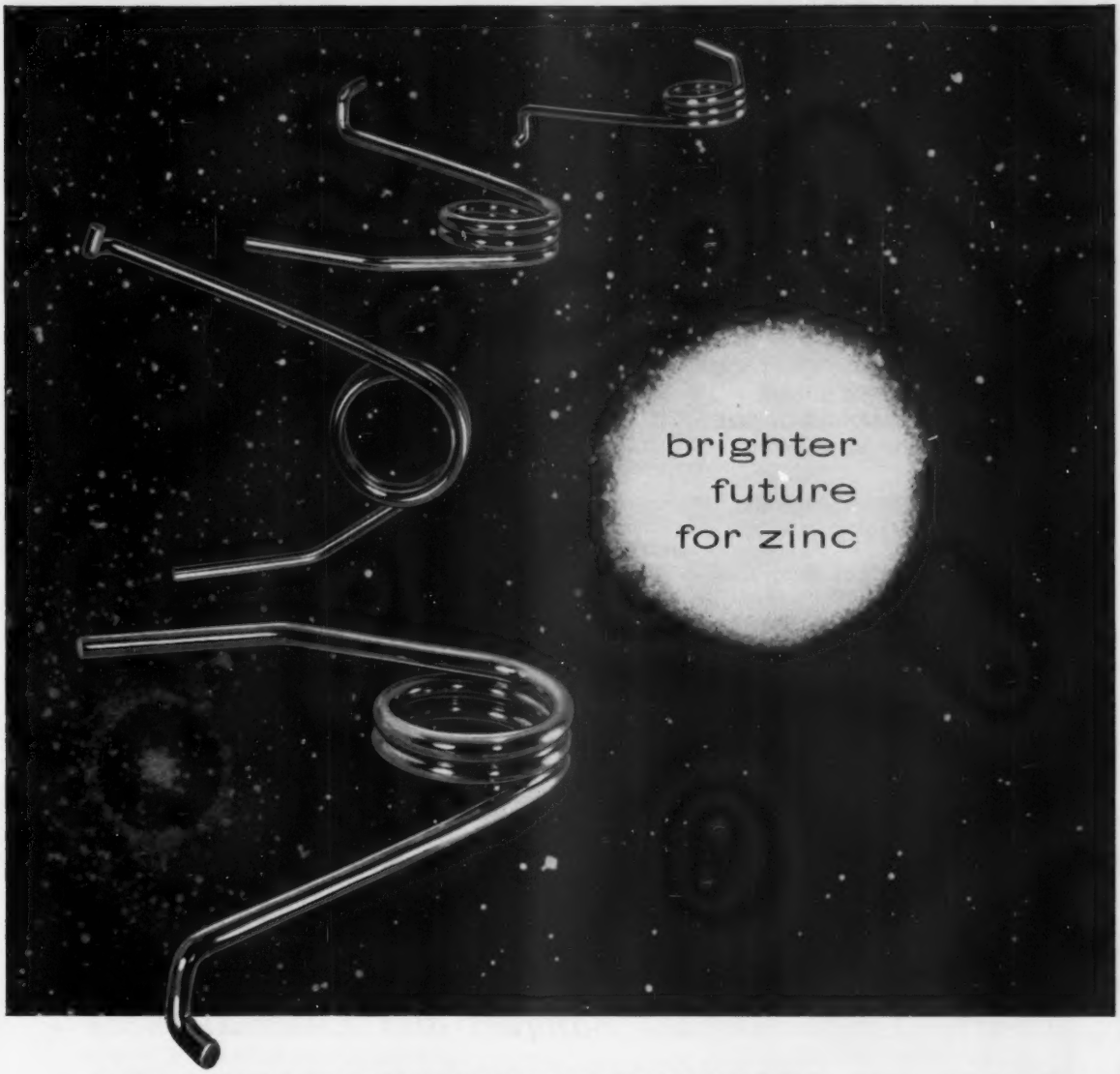

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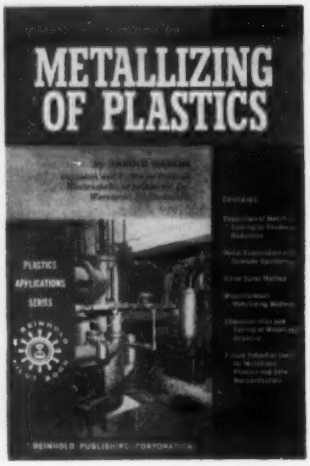

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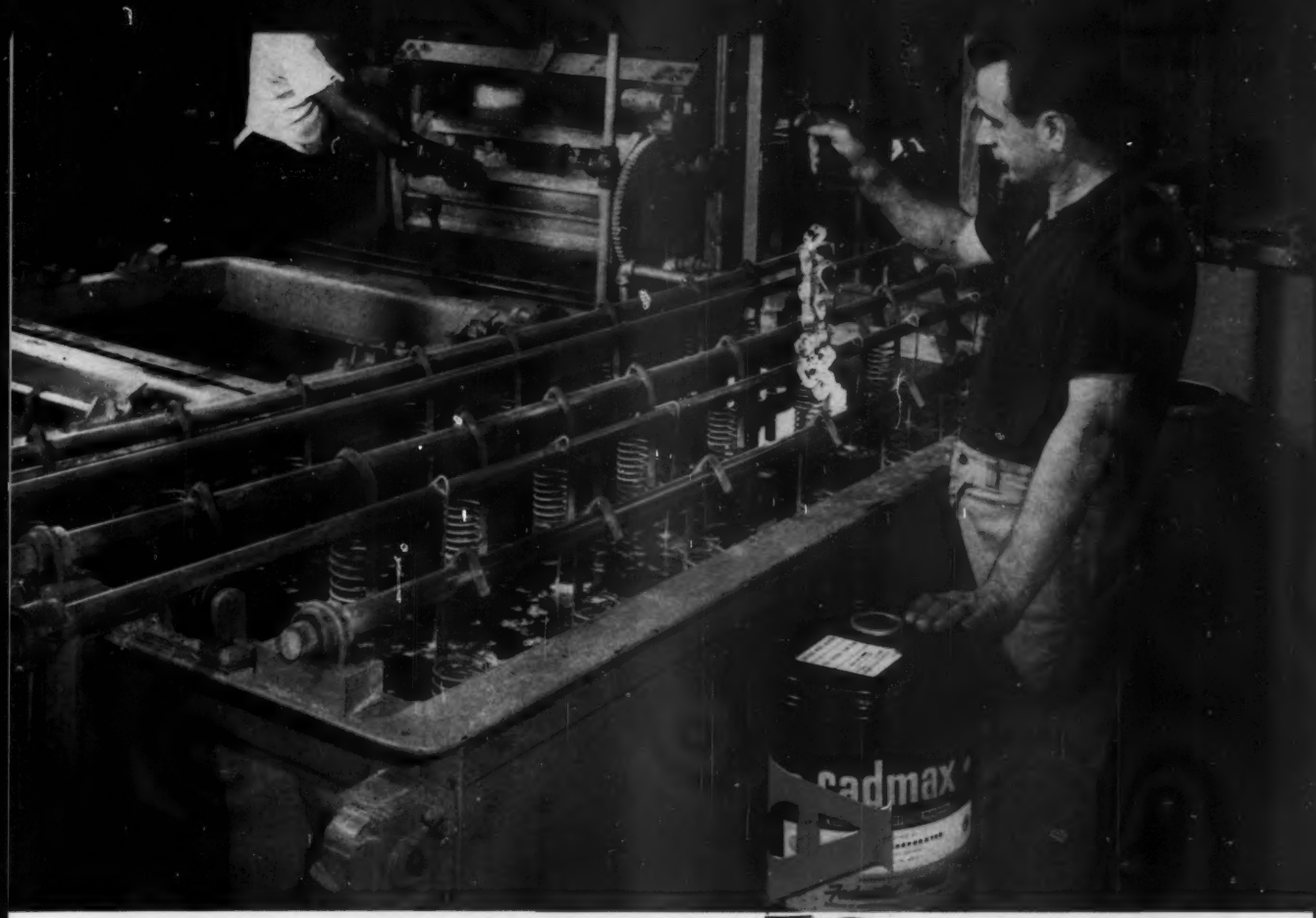

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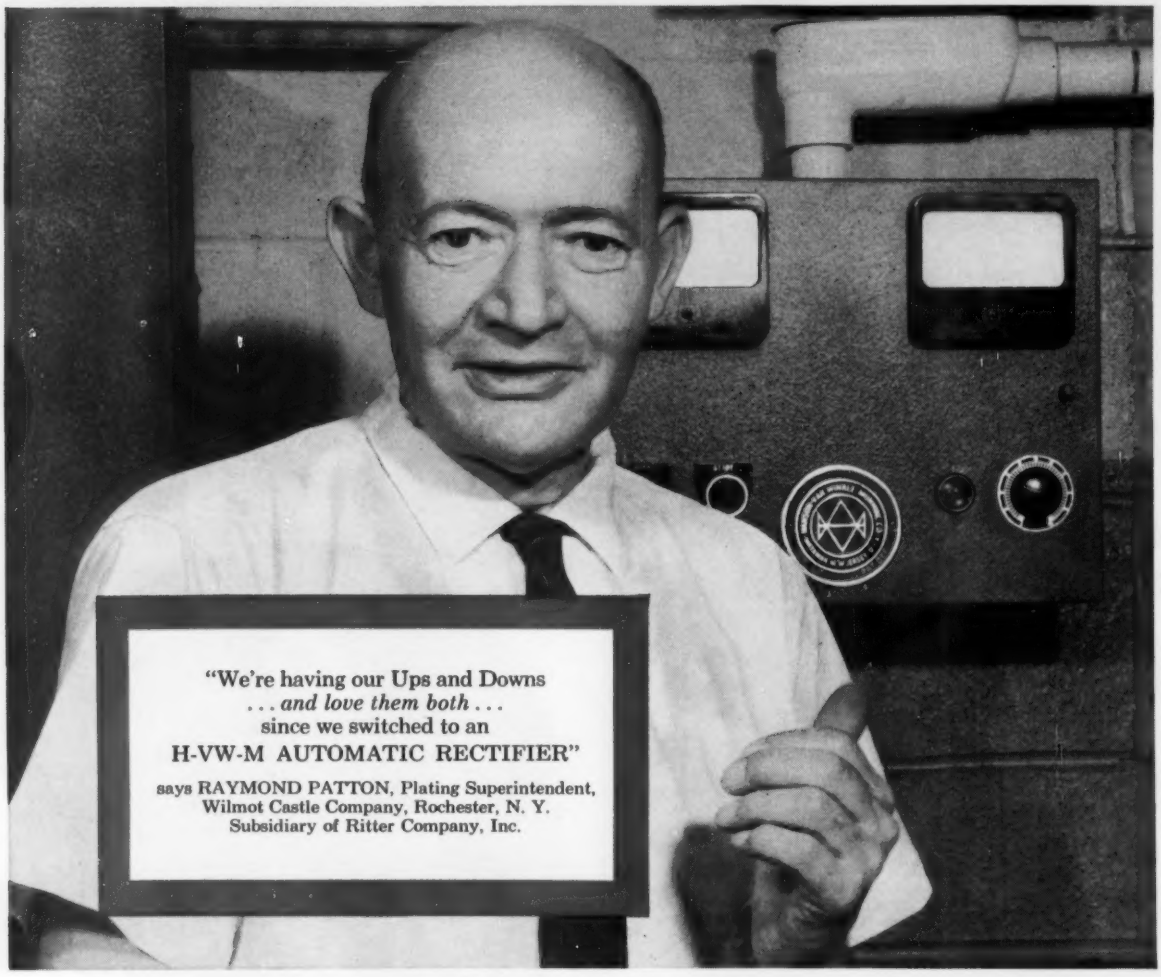

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ESTABLISHED 1903 VOLUME 59 • NUMBER 4 • APRIL, 1961

FROM LITTLE ACORNS

In the past, once fixed charges had been covered, and the break-even point reached, a relatively small percentage increase in sales generated a geometric rise in profit. The last year, however, has shown a consistent pressure toward higher unit operating costs, which even greater sales volume failed to stem. Those who have followed the financial sections of their newspapers recently could not fail but to notice that numerous companies were reporting increased sales along with lower net profits.

We all are aware that rising labor and material costs are the main culprits, and it is also obvious that, in the foreseeable future, we can expect no reversal of this trend. Therefore, the area of maneuverability in the imperative need to slash operating costs is seriously limited, and we are reduced to the necessity of searching out and eliminating every possible source of waste, no matter how small.

In the finishing department there are many such areas, some offering the recovery of dollars, and others only of pennies — but, like little acorns, they can really grow. We are not concerned at the moment with the broad aspect of automation, but with the relatively inexpensive money-savers. Take water in the plating room, for example. The ninety per cent water saving inherent in the countercurrent double rinse needs no amplification. But, rinses which are not turned off during lunch hours will alone account for a thousand dollars of a $10,000 yearly water bill. For not much more than this single year's waste, automatic conductivity control equipment will not only take care of it but will also eliminate water wastage during the rest of the day.

Take the polishing department. Is the operator using too much buffing compound? Perhaps liquid compositions are the answer, with equipment available at small cost. Is he wearing down his buffs too rapidly because the spindle is operating at the wrong speed? And, is the company buying him the most economical buff or compound per part finished, or the cheapest per pound? Waste can be reduced here without spending any money at all; all that is needed is a little education.

Take the paint room. Does the part lend itself to electrostatic spraying? It doesn't have to be automatic; the saving in overspray from a single gun will quickly pay for the unit. Is the purchasing department looking for the lowest price per gallon or the maximum mileage per dollar? Does the sprayer use his regular lacquer solvent for cleaning his equipment? A special, cheap solvent for the purpose will do just as good a job, and just as quickly.

These are only a few sources of waste in the finishing department; there are many more. The trouble has been that, taken individually, there is often very little to be gained by correcting a wasteful condition. It sometimes seems pretty picayunish even to bother with the pennies involved. But, the pennies add up to the dollars which make more expensive the cost of doing business. It is just these dollars which are going to determine a company's competitive position in days to come.

Nathaniel Hall

Microhardness of Silver Deposits

Modified Plating Baths

By S. Ramachandran and N. V. Parthasaradhy, *Central Electrochemical Research Institute, Karaikudi-3, India*

SILVER electroplates have assumed in recent times a very important position, aside from the decorative jewelry industry. Quinn[1] has referred to silver electroplate as the only choice among precious metals for its relatively low cost coupled with high electrical and thermal conductivities, in medium and heavy duty electrical contacts and for heavy electrical engineering purposes. Further, in the assembly of radio and other communication equipment, different metals must be used for various considerations. In such an assembly, the problem of contact potential, which may adversely affect the performance of the equipment, may become important, and Marsh[2] has drawn the important role played by the electroplates in mitigating the same.

Among the metals plated, silver is an essential finish for high frequency conductance. An additional feature is that the contact potential of plated silver over copper is very low. Again, Wright[3] and Blum[4] have brought out the importance of silver plating in bearings.

Hardness and Other Properties

In many of the above uses, the question of wear-resistance plays an important role, and the wear-resistance has been associated, in some measure, with the hardness of the metal. In practice, microhardness measurement is the rational way of assessing this property of thin foils, electroplates, etc. Weiner and Klein[5] have concluded from their studies that microhardness tests give a good indication as to the wear resistance of an electrodeposited coating.

It is well known that the general properties of the electroplate, which include external appearance, hardness, adhesion, and brittleness, are modified profoundly by plating conditions, such as current density, temperature, composition, and the purity of the bath, with or without addition agents. Consequent to these factors a very close control of plating conditions is warranted, and Mott[6] has pointed out that microhardness measurements afford a quick and nondestructive method of controlling the standardized conditions. Experiments by Keil & Wüst,[7] and Keil & Merkle[8] have reinforced the validity of the above conclusion. The latter authors have brought out a parallelism between microhardness and the percentage of the alloying element, lead, in the silver-lead alloy plated by them. The formulation of new baths for silver plating and the study of the properties of deposits from such baths assumes importance in a variety of engineering industries. Against this background, the present work has been initiated in the authors' laboratory.

Difficulties in Measuring Microhardness

(a) THE CONCEPT:

Serious studies of microhardness of electroplates in any form have been of recent origin and, as such, the concepts met with have not been clearly defined. Bückle[9] in his fairly exhaustive review on microhardness testing has brought out the need for definite classification in regard to assessing the hardness of a material. With reference to macro-hardness, he has suggested two regions

(1) that of low load hardness (with loads of 200 g. to 3 kg.) and
(2) that of macrohardness (with loads above 3 kg.)

In regard to microhardness, the position is far from being clear. Different authors have taken different loads for the measurement of hardness and the entire field in this region is definitely nebulous. Bückle[9] has suggested a load region of lowest possible load to a maximum of 200 g. Many workers, therefore, have hailed Bückle's classification as being quite timely. He has further restricted the range of the loads to 1 to 50 g., for the measurement of microhardness.

(b) MEASUREMENT TECHNIQUE:

Among the different methods of measurement of microhardness, that most widely accepted is the static indentation method, employing Vickers pyramidal diamond indentor with a vertex angle of 136°. Such a measurement is beset with a number of difficulties in regard to preparation of the specimen, its mounting on the instrument, the loading and the actual measurement.

PREPARATION OF THE SPECIMEN:

The specimen must have a smooth and bright surface of uniform grain size. Difficulties are introduced if the specimen under study is polyphased, and contains inclusions. In such cases, the microhardness

measurement may give widely varying values because of the variation of the material under test. Mechanically polished surfaces are work-hardened. Therefore, the values may be out of accord with the hardness of the sub-surface, which is the actual material under study and, in case of very low loads, say of 5 g. and less, if the depth of indentation is very low (i.e., even lower than the thickness of the Beilby layer), then the measured value will be erroneous. Therefore, in general, the best recommended practice for preparation of surface is by electropolishing,[10] which (a) removes the Beilby layer, (b) removes the work-hardened layer, and (c) gives a bright finish. Such a finish facilities the measurement of the diagonal of the indentation impression, which ultimately gives the hardness value.

MOUNTING THE SPECIMEN:

The specimen should be mounted so that the face to be examined is perpendicular to the direction of the indentor.

LOADING:

The load rate during indentation should be slow and uniform, as otherwise errors due to inertia might creep in. The error thus introduced is increased considerably with very low loads. During indentation, freedom from vibration is necessary, to avoid erratic hardness values, and the duration of loading must be for a definite period, usually 15 to 30 seconds. A bright surface and uniform illumination will be an advantage to the observer. On top of all these difficulties encountered in the measurement comes the personal error of the observer, which may vitiate the values.

These difficulties are enhanced in the evaluation of microhardness of electroplates because, if the thickness of the deposit is not adequate, the hardness of the basis metal will come into play. Therefore, experiments must be carried out initially to select the optimum thickness of the electroplate on the basis metal which can be taken for the measurement of microhardness characteristic of the deposit.

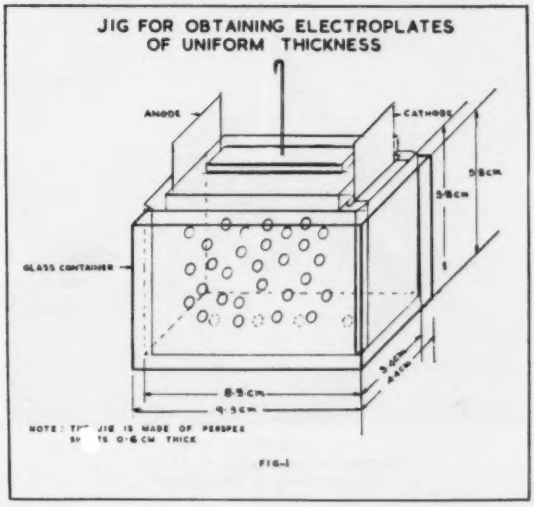


FIG.1

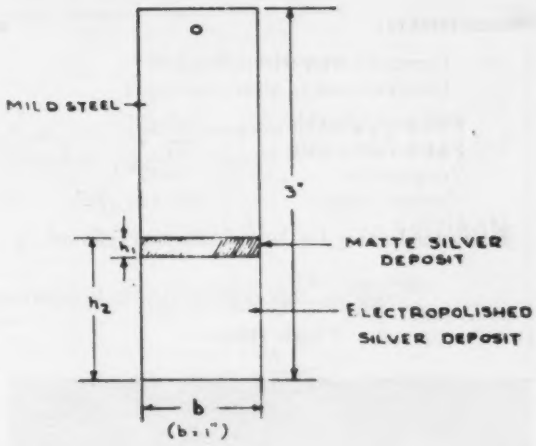


FIG.2.

In this connection, Ramanathan's[11] work on electrodeposited Sn-Ni alloy on brass has shown that the minimum thickness must be 16 times the depth of indentation. Peters and Knoop[12] have given an optimum thickness value of 14 times the depth of indentation for electroplated chromium. The procedure adopted in the reference cited (11) using varying loads is not applicable where the differences in microhardness between the deposit and the basis metal are small, as in the investigation under progress. In silver plating, the most commonly used basis metal is mild steel, copper, or brass. The microhardness values for silver electroplate and mild steel are 75 V.P.N. and 142-169 V.P.N. respectively, as against the values cited[11] for Sn-Ni deposit and brass of 710 V.P.N. and 125 V.P.N. respectively. Hence, the use of varying loads for determination of microhardness was discarded. In fact Bückle[13] has pointed out that the precise nature of the relationship between hardness and load has always been the subject of lively controversy, which continues up to the present time. Therefore, the method adopted here is to employ a known constant load. Accordingly, the more widely accepted value of 25 g. load has been selected, as typically representing the load for microhardness measurement. It will be of interest to note that an identical load has been chosen by Bergsman[14] for the measurement of microhardness of silver electroplate, and even for chromium.

Experimental

PREPARATION OF THE SPECIMEN:

In all the experiments, the basis metal comprised 1" x 3" mechanically polished, mild steel plates with microhardness in the range 142-169 V.P.N. This variation in microhardness value of the basis metal, cut from the same stock of material, could not be avoided in the absence of facilities for normalizing the specimens. Also, no attempts were made to remove the stresses due to cold working as a result of grinding and polishing. The following pretreatment and plating cycle was adopted in all cases.

PRETREATMENT:

(a) Degreased with trichlorethylene
(b) Electrocleaned in alkaline cleaner:

Sodium hydroxide	35 g./l.
Sodium carbonate	25 "
Temperature	70-80°C.
Current density	144 amp./ft.^{2}

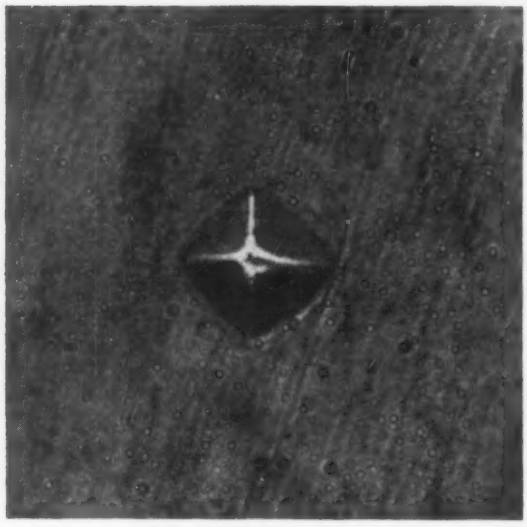
Cathodic cleaning for 1-2 minutes was followed by anodic cleaning for 1 to 2 minutes.

(c) Dipped in 5% (by vol.) H_2SO_4 for 15 seconds.
(d) Given a strike:

Silver cyanide	1.7 g./l.
Potassium cyanide	75.0 "
Current density	10 amp./ft.^{2}
Time	20-30 seconds
Temperature	30°C.

PHOTOMICROGRAPHS OF MICROINDENTATION IMPRESSIONS FORMED AT A LOAD OF 24.5 G.

MILD STEEL

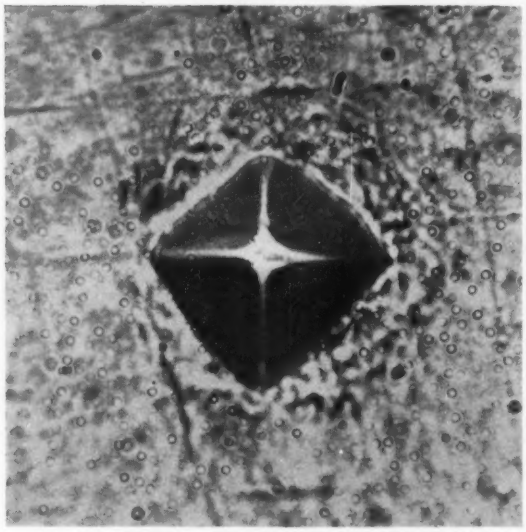


3(a)
Diagonal of Indentation = 16.9 μ
Microhardness = 159 Kg/mm^2

SILVER ELECTROPLATE
Thickness 0.03 mil

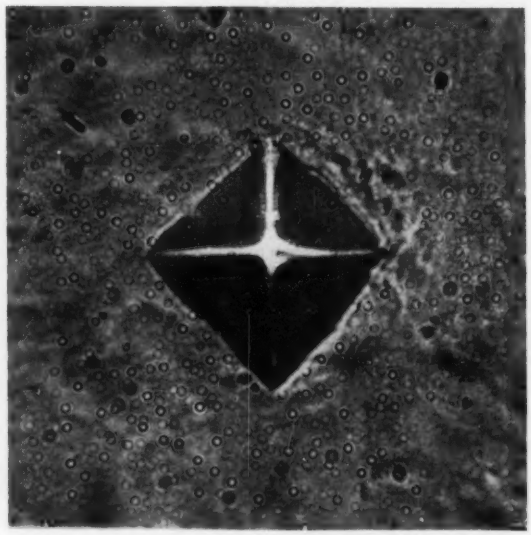
3(b)
Diagonal of Indentation = 20.4 μ
Microhardness = 109 Kg/mm^2

SILVER ELECTROPLATE
Thickness 0.15 mil



3(c)
Diagonal of Indentation = 23.0 μ
Microhardness = 86 Kg/mm^2

SILVER ELECTROPLATE
Thickness 1.02 mil



3(d)
Diagonal of Indentation = 24.4 μ
Microhardness = 76 Kg/mm^2

Fig. 3

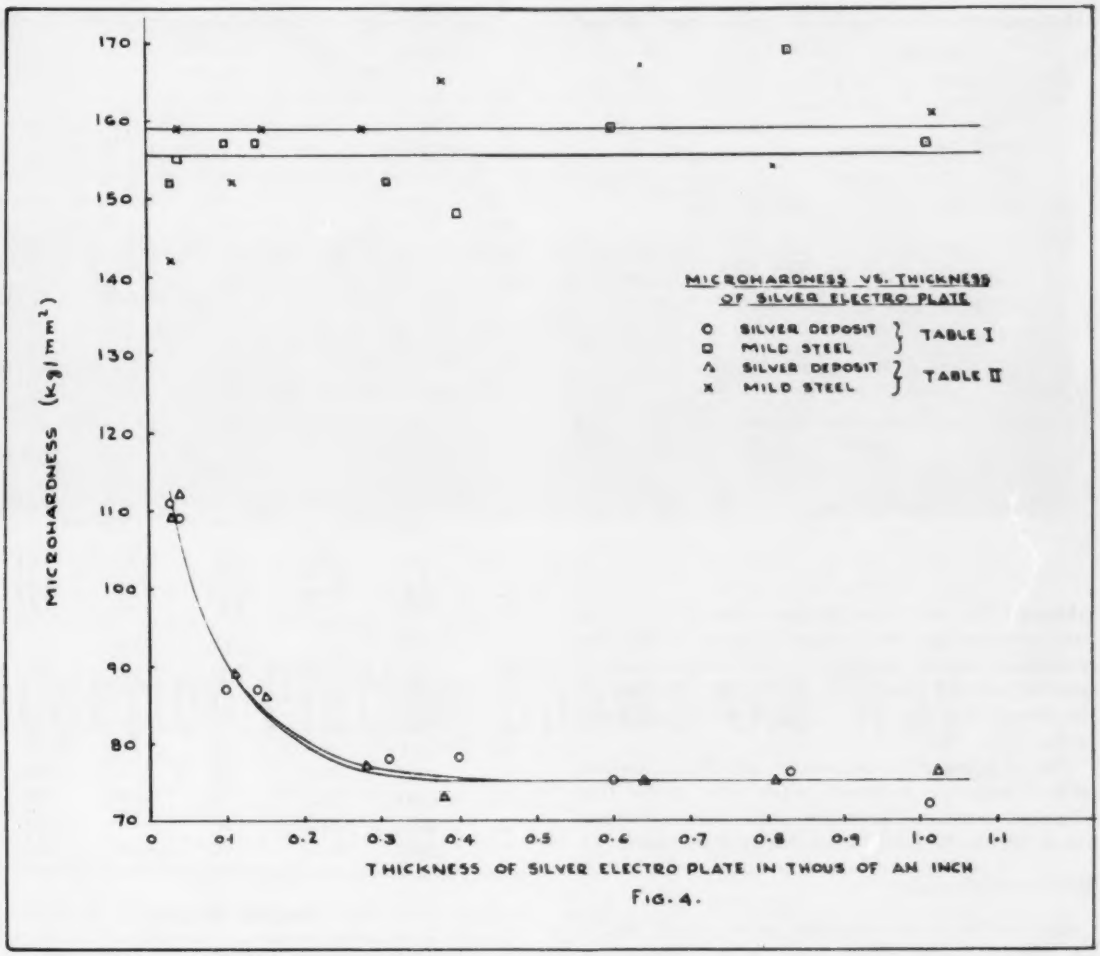


FIG. 4.

PLATING:

Plating was conducted in a cyanide-nitrate bath of the following composition:

Metallic silver	17 g./l.
Free potassium cyanide	23 "
Total potassium cyanide	43 "
Potassium carbonate	27 "
Potassium nitrate	130 "
Anode	Silver
Current density	5 amp./ft.^{2}
Temperature	30°C.

This is identical with Wood's[15] bath and has been chosen for its lower cost compared with the conventional all-cyanide bath. As uniformity in thickness of deposit is of vital importance, a special jig (Fig. 1), was made of Perspex, as designed by Ramachandran & Venkatakrishniah,[16] and which has been used extensively in this laboratory. This method also ensures the preparation of the plates under reproducible conditions.

By plating for different periods, electroplates of varying thicknesses were prepared. Only about one sq.in. area of the panel was plated. The unwanted portion of the basis metal was stopped off with paraffin wax. The matte silver deposit thus obtained was electropolished in the conventional cyanide silver plating bath of the following composition:

Metallic silver	27 g./l.
Free potassium cyanide	34 "
Total potassium cyanide	56 "
Potassium carbonate	55 "

The conditions during electropolishing were:

Applied voltage	6.5 V.
Current	120 mA.
Anode	Matte silver electrodeposit
Cathode	Stainless steel
Bath voltage	1-2 V.
Time	40 seconds
Electrode distance	1.5 in.

This electropolishing served the purpose of a metallographic polishing and also towards proper definition of the outline of the indentation impression during measurement. Care was taken to maintain the uniformity of thickness during electropolishing by making use of a suitable jig. Invariably a portion of the matte deposit towards the top remained unpolished, because the electropolishing bath level had to be maintained below the top edge of the silver plate. The

thickness of the electropolished deposit was calculated as follows: (See Fig. 2).

Weight of mild steel panel ..... $= W_1$ g.
" + matte silver deposit ..... $= W_2$ g.
" + electropolished deposit together with the residual matte deposit ..... $= W_3$ g.

Weight of unpolished matte deposit

$$= \frac{h_1}{h_2} (W_2 - W_1) \text{ g.}$$

$\therefore$ Weight of electropolished deposit alone

$$= (W_3 - W_1) - \frac{h_1}{h_2} (W_2 - W_1)$$

Area of electropolished electrodeposit $= (h_2 - h_1) . b$ sq. cm.

Density of silver $= p$ g./cc.

$\therefore$ Thickness of electropolished silver plate in mils

$$= \frac{W}{(h_2 - h_1)\, b\, p \times 2.54}$$

Although the above weight-area methods is not a very accurate one, the average thickness of the electropolished deposit has been obtained as accurately as possible with the available data. It is this thickness of the deposit that has been included in the subsequent tables.

The thickness of the deposit has also been measured with a magnetic thickness tester. The values thus measured compare favorably with those obtained above, within the limits of accuracy of the tester.

METHOD OF TESTING:

Microhardness measurements were carried out on the electropolished silver plate in a metallurgical microscope. The specimen was placed in position with the surface to be tested facing downwards. The surface was then brought into focus and the objective of the microscope replaced by the Vickers pyramidal diamond indentor. The specimen was lowered slowly and uniformly onto the indentor by means of the fine focusing mechanism until a load of 24.5 g. was applied. (This is the calculated weight as per the divisions on the calibrated weight scale. It will be difficult to get at that reproducible reading which will correspond to 25 g. exactly.) An indentation period of 20 seconds was used, after which the specimen was raised off the indentor and the latter replaced by the microscope objective. The diagonal of indentation, in microns, was measured. For each specimen, a number of indentations were made at different places over the test surface, in order to cover the limits of experimental error and an average of the indentation diagonal (d) was obtained. Similar measurements were made over the mild steel basis metal as well (Fig. 3). The microhardness Hμ was obtained from the relation

$$H\mu = \frac{1854.4\, L}{d^2}$$

where 'L' is the load applied in grams and 'd' is the indentation diagonal in microns.

The following precautions were taken during the measurements in order to minimize errors:

1) The specimens were prepared in a similar way throughout, as described above.

2) The load was applied slowly and uniformly in order to avoid errors due to inertia effects.

3) During the period of indentation, the working table was not disturbed, in order to minimize errors due to vibration. Also, if there was accidentally any slamming of the door and the like, the measurement was discarded.

The microhardness of silver deposit 0.35 mil thick over brass and that of brass alone were also measured at a load of 24.5 g.

Results and Discussion

Typical results are presented in Tables I and II.

TABLE I

	Silver deposit over Mild Steel			Mild Steel*	
No.	Thickness (mil)	Diagonal of indentation (μ)	Microhardness (Kg/mm²)	Diagonal of indentation (μ)	Microhardness (Kg/mm²)
1.	0.03	20.2	111	17.3	152
2.	0.04	20.4	109	17.1	155
3.	0.10	22.8	87	17.0	157
4.	0.14	22.9	87	17.0	157
5.	0.31	24.1	78	17.3	152
6.	0.40	24.2	78	17.5	148
7.	0.60	24.7	75	16.9	159
8.	0.83	24.5	76	16.4	169
9.	1.01	25.1	72	17.0	157

TABLE II

	Silver deposit over Mild Steel			Mild Steel*	
No.	Thickness (mil)	Diagonal of indentation (μ)	Microhardness (Kg/mm²)	Diagonal of indentation (μ)	Microhardness (Kg/mm²)
1.	0.03	20.4	109	17.9	142
2.	0.04	20.1	112	16.9	159
3.	0.11	22.6	89	17.3	152
4.	0.15	23.0	86	16.9	159
5.	0.28	24.3	77	16.9	159
6.	0.38	24.9	73	16.6	165
7.	0.64	24.7	75	16.5	167
8.	0.81	24.7	75	17.2	154
9.	1.02	24.4	76	16.8	161

*Refers to the basis mild steel plate bearing the silver deposit of thickness given in columns 1-9 in each of the Tables. This note might be kept in mind while studying the curves as well.

A plot of microhardness versus thickness of the silver deposit was obtained for each of the sets of results and are given in Fig. 4.

An inspection of the plot will show the hardness at the outset is less than the basis metal, which is as it ought to be. For, the thickness of the plate is inadequate to eliminate the influence of the basis metal. But the thin plate itself has asserted its existence, thus lowering the hardness value of the basis steel.

(*Continued on page* 60)

Superior Plating Shows the Way

SUPERIOR Plating Inc. was anything but a lusty infant at the time of its birth 41 years ago in Minneapolis: The "organization" was comprised of *L. M. DeMars*, the founder, and three employees. At this time Minneapolis was largely regarded as the "gateway to the agricultural northwest." Manufacturing and heavy industry were only a relatively small part of its total economy.

From the very beginning, DeMars who today serves as chairman of the firm's board of directors proved himself creative and aggressive. The small firm steadily expanded, both in services and personnel. Growth since its origin in 1919 forced moves to four different locations — in 1928, 1935, 1940 and 1960.

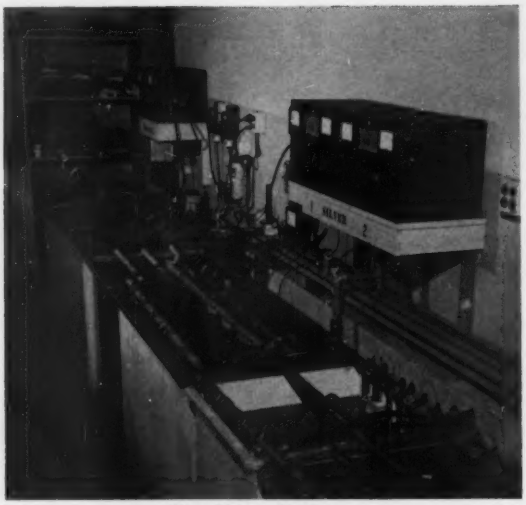
In 1950, another step forward took place within Superior's corporate structure. At this time, *Al Leonard* who had been moving up steadily from within the ranks, was named president. Today, with Leonard still at the helm, the firm has 300 employees, occupies 110,000 square feet of floor space under a single roof, and offers some 52 different metal finishing processes. It is described as "the largest metal finishing job shop in the United States." Its services are largely concentrated in a five-state area, including and adjoining Minnesota.

Indicative of the recognition Mr. Leonard has earned as a leader in the field of metal finishing was his election in 1959 as president of the *National Association of Metal Finishers*. It was in this capacity that the Minneapolis industrialist recently completed a 44-day trip to nine countries and 15 major cities to inspect outstanding metal finishing plants and operations.

Obviously, a success story of this kind calls for a closer look at the factors involved. A Leonard-conducted tour of the Superior facilities provides the answers.

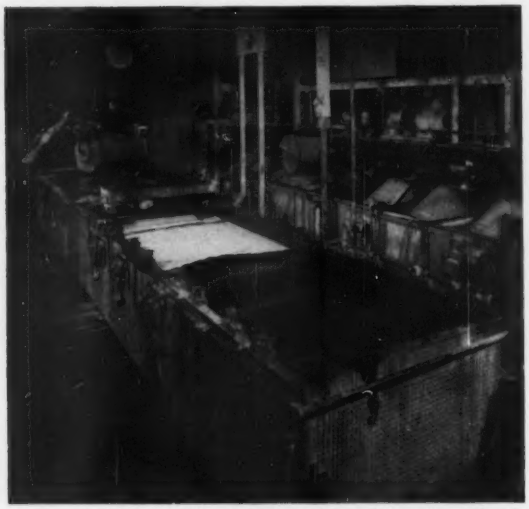
Anyone viewing the modern and attractive plant, into which the company completed its latest move on June 1, would little suspect that the property had been an abandoned street car barn two years ago. Today it is a model of efficiency and organization. The stylish main entrance and two-story lobby might well be those of an advertising agency, an architectural firm, or a furniture show room. Immediately behind the lobby is a large, bright, well-lighted office with plenty of elbow-room for its occupants. Directly back of the office is a spacious area soon to be converted into a conference room. Adjacent to it is a lunchroom for the employees.

Adjoining the lobby and office is a truck-high enclosed shipping and receiving dock which will accommodate 11 trucks or semi-trailers. All incoming and out-going work and material is handled by a crew of 12 men using fork lift trucks which move it on pallets directly to the finishing areas, or else stack it on a series of three-tier pallet storage racks. Work with heavy grease or oil is sent to a central cleaning line, and from there to the various departments. Objects coated with unusually heavy scale are cleaned

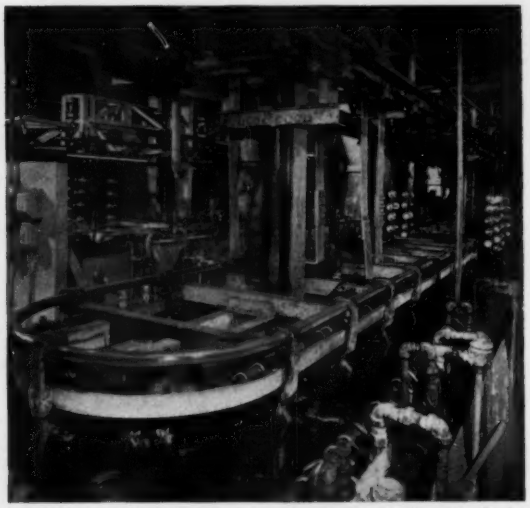


Silver Plating Equipment.

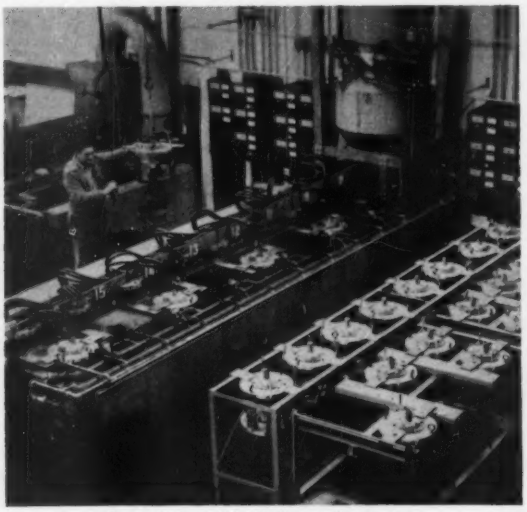
View of the polishing department.



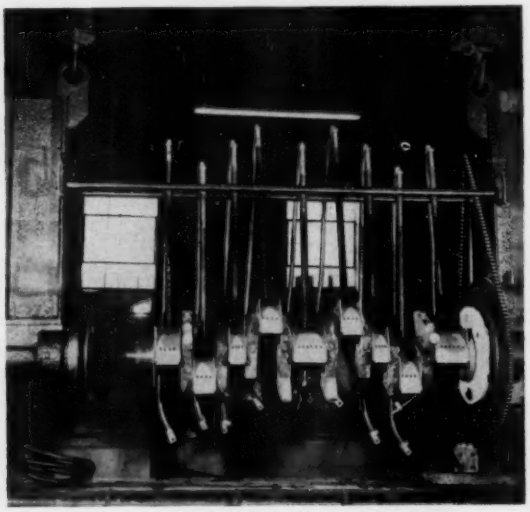
Foreground—Horizontal barrel equipment for plating zinc and cadmium; Background—Barrel automatic equipment for plating zinc.



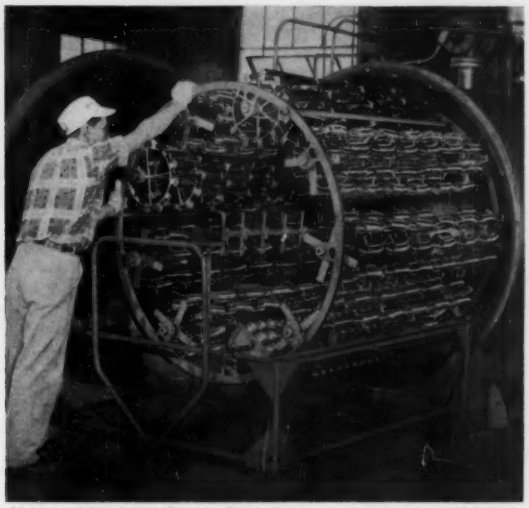
Foreground—Nickel-chrome automatic plating equipment; Background—Copper automatic plating equipment.



General view of hard chrome department.



Locomotive crankshaft masked and ready for plating.



Vacuum Metalizing Dept.—Removing parts from vacuum chamber.

Paint Dept.—Spray painting on conveyor line.

Paint Dept.—General view of conveyor and overhead oven.

Paint Dept.—General view of batch ovens.

Phosphating Dept.

Portion of Shipping-Receiving Dept.

in a centrifugal grit blast machine. Prior to painting, all steel work is processed in a cleaning, pickling, and phosphating hoist line 100 ft. long over tanks 14′ x 4′ x 5′.

Management credits much of its phenomenal growth to exceptional service and high quality. Because its own maintenance department is equipped to make tanks and plating racks, the company can offer time-pressed customers fast over-night service on even complicated plated parts.

Quality control is a fetish with Al Leonard and his associates. The modern, complete 32 x 32 ft. central laboratory is the "show-place" of the sprawling, efficient plant. Analysis of all plating solutions and paint pretreatments are taken at least once a week. Some solutions are checked daily, and others as often as three times daily. This laboratory is equipped with small plastic tanks for research and development work in plating on titanium, molybdenum, zirconium, tantalum, and columbium. There are four full time chemists on the payroll.

The precious metal plating department, of which the firm is particularly proud, has its own quality control laboratory where sample parts are micro-sectioned, mounted in plastic, polished, etched, and inspected under a metallographic microscope. An electronic thickness tester is used to assure uniform thickness of the plating which, in most instances, must meet unusually rigid specifications. The precious metal plating department itself is in a separate room containing a modern, streamlined series of tanks and precision controls which apply rhodium, gold, silver, platinum, and other precious metals on electronic and missile parts.

The polishing department is a model of efficiency, with the work flow streamlined to perfection. Superior uses automatic rotary head polishing machines. Most of the plating work, with exception of small runs, special finishes, and racked zinc work, is finished in full automatics, including an automatic zinc barrel, a copper automatic, a nickel-chrome automatic and a cadmium automatic. The racked zinc work is processed in a hoist line 80 ft. long. The hard chromium department processes crankshafts, pistons, paper rolls, and aircraft diesel cylinders. The firm is one of the few shops in the area that can hard-coat aluminum. It also offers fluidized bed coatings.

Production Office.

A section of the laboratory.

Steam is supplied by boilers with a total of 625 horsepower. All tanks are well ventilated, and the exhaust air is replaced by an air tempering system. An input air room is located directly behind and above the boiler room. Fresh air is drawn through roof input ducts totalling 60 square feet in area, and through a bank of steam coils with a frontal area of 400 square feet. The air is then drawn into twin centrifugal blowers 12 ft. high x 4 ft. wide, and out through ductwork that distributes the air to shop areas. The system is rated at 120,000 cubic feet of fresh air per minute.

Plating current is supplied by generators and rectifiers with a total capacity of 100,000 amps. The power service for the plant is supplied at 13,800 volts through underground service cables. At a 1000 Kva transformer station, located near the center of the plant, the incoming 13,800 volt, 3 phase, 60 cycle power is stepped down to 240 volts, and is distributed throughout the plant by a four-wire system that makes available 120 volt single phase at all power panels for plant lighting and portable tools.

In addition to many types of electroplating, Superior does vacuum plating, plastisol coating, and organic finishing. The organic finishing department contains an 800 ft. conveyorized painting system which incorporates a three zone, gas-fired oven encompassing 350 ft. of conveyor line. In this line, are three water-wash spray booths and a dry booth. The small lot section of this department contains six water-wash type batch spray booths, and six batch ovens 6 x 8 x 17 ft. deep. The company also offers all types of baked finishes, including the popular leatherette coatings.

Plastisol work is processed in two continuous conveyor ovens — one 28 ft. and one 30 ft. All types of metal parts such as wire baskets, photo developing tanks, conveyor rollers, etc. are treated in this department. Vacuum plating is done in a 72 inch vacuum coater.

As impressive as are its growth and achievements to date, Superior Plating Inc. is by no means content to "rest on its laurels." Under the dynamic leadership of Mr. Leonard it continues to expand and improve by the day, ever increasing its stature as a pace-setter in the national field of metal-finishing.

Plated Coatings in Boriding of Steel

By Larissa Domnikov, *Process Analyst A, Norair Div., Northrop Corp.*

THE boriding process, similar to case-hardening, consists of saturating the surface of steel parts with boron for the purpose of forming of a very hard and abrasion-resistant diffusion layer. Boriding increases the wearability of such parts more than four times. Investigation of work properties of the borided layer indicated that this process could be very useful in many applications provided the right techniques are used.

However, sometimes it is undesirable to have the entire surface of parts borided because of difficulties presented by the hard layer in cutting, machining, and other operations. Protection of local areas from diffusional saturation with boron is very difficult, because boriding conventionally is conducted by electrolysis in molten borax, $Na_2B_4O_7 \cdot 10H_2O$. The part is made the cathode and is placed in the bath in such a manner that the surface to be borided is completely immersed. If the part is only partially immersed, a severe attack on the metal takes place at the interface formed by the bath surface and the surrounding atmosphere. In a recent article published in the Russian Journal "Metal Science and Heat Treatment"[1], Russian researchers described their studies of electrodeposited coatings for the purpose of protection of local areas in boriding of steel. Nickel and copper deposits were investigated as protective coatings. From published data[2] it is known that boron does not dissolve in nickel, and forms only nickel borides: Ni_2B_3, NiB, NiB_2, Ni_3B_2. No information exists on reaction of boron with copper. In the Periodic Table, copper belongs to the adjacent group in the same period with nickel and possesses almost the same atomic diameter. This fact induced the Russian researchers to experiment with both copper and nickel coatings for protection of local areas from boriding.

Test specimens were made of steel "35" (0.35% C, 0.26% Si, 0.74% Mn, 0.037% S, 0.012% P) and steel "50" (0.49% C, 0.50% Mn, 0.35% Si, 0.026% S, 0.20% P), 10 and 15 mm in diameter and 15 mm thick. Nickel plating was conducted at room temperature in a bath of the following composition:

Nickel sulfate	200 g./l.
Boric acid	30 "
Sodium fluoride	5 "
Sodium chloride	15 "
Current density	0.8-0.9 amp./dm.^{2}
Voltage	2.5-3

The thickness of the deposits was 0.008-0.036 mm.

Copper plating was conducted in a sulfate solution of the following composition:

Copper sulfate	250 g./l.
Sulfuric acid (H_2SO_4)	5 "
Current density	1.5 amp./dm.^{2}

The thickness of the deposits was 0.05-0.35 mm.

Following nickel and copper plating, the test specimens were borided electrolytically according to the specified method[3] at 950-960°C. for 1, 1.5, 2, and 4 hours.

Nickel as a Resist

Microstructural analysis of borided nickel plated specimens indicated that the nickel layer does not prevent diffusion of boron. A borided layer of identical nature with the one found on ordinary steel samples is formed on the steel surface of the nickel plated specimens.

Fig. 1 shows microstructure of steel "50" with a 0.020 mm thick nickel plate before boriding. Fig. 2 shows the same sample after boriding at 950-960°C.

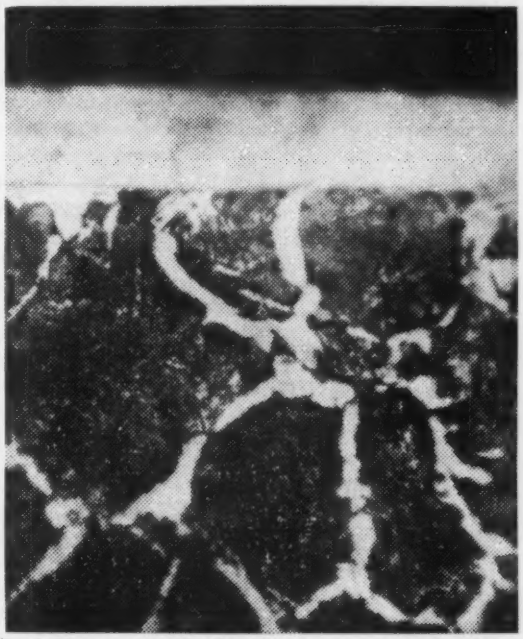


Fig. 1. Microstructure of nickel plated sample of steel "50". X400.

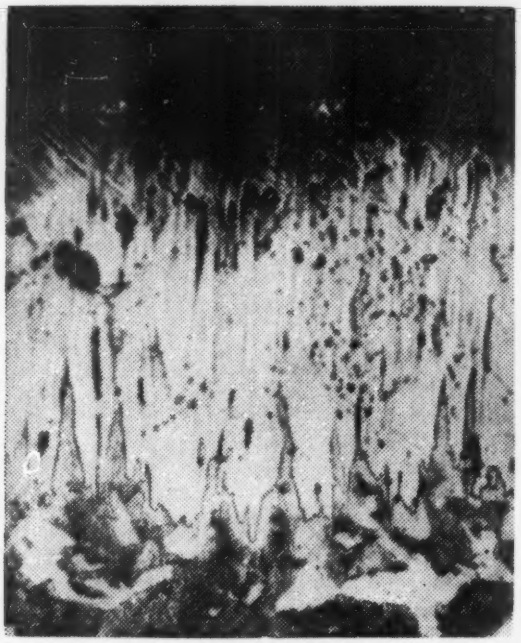


Fig. 2. Microstructure of nickel plated sample of steel "50" after boriding for 2 hours at 950-960°C. X350.

for 2 hours. On the surface of the sample, a borided layer was formed consisting of columnar, dendritic crystals, characteristic of the borided layer.

Apparently, nickel, similarly to the ferrous basis metal of the sample, enters a reaction with molecular boron and forms a continuous diffusion layer. This explains the similarity between the structure of the borided layer of the nickel plated specimens and the ordinary structure of the borided layer of steel. Undoubtedly, borides are formed in the diffusion layer, which fact is proven by the layer's microstructure and its high hardness. Microhardness measurements on a "PMT-3" instrument with a load of 100 g. produced values in excess of 1500 kg./mm.^{2} (see Table). A wide variation in microhardness readings of the borided layer indicates nonhomogeneity of its structure.

In some areas of the borided layer of nickel plated specimens, the microhardness readings were 2627-2825 kg./mm.^{2} (not recorded in the Table); in steel samples without electroplated coatings they were 2142-2290 kg./mm.^{2} Moreover, in the steel samples without electroplated coatings, the borided layer had a lower ultimate hardness. Apparently, nickel coatings result in a formation of borides of a more complex structure in the diffusion layer.

TABLE

Samples of steel "50"	*Microhardness of borided layer, kg./mm.^{2}*	*Microhardness of electroplate, kg./mm.^{2}*
Without electroplate	1530-1895	—
Nickel plated	1590-2015	300-400
Copper plated	1000-1600	80-140

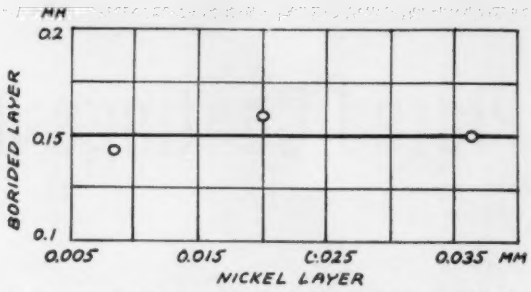


Fig. 3. Effect of thickness of nickel plate on thickness of borided layer after boriding for 2 hours at 950-960°C.

Figure 3 shows a relationship between the thickness of the diffusion layer formed in boriding for 2 hours at 950-960°C. and the thickness of the nickel plate. Increasing the thickness of the nickel plate from 0.008 to 0.036 mm. did not result in increased thickness of the borided layer.

Copper as a Resist

Microstructural analysis of samples which received copper plating indicated that molecular boron does not react with the copper layer, which remains unchanged on the surface of the samples and retains its clearly defined structure. However, the copper layer prevents boron from entering the steel although, in some cases, boron does diffuse through the copper plate.

The study of the copper plated samples after boriding under different conditions indicated that the degree of diffusion of boron into steel through the copper layer depends on the thickness and the quality of the copper deposit. It is interesting to note that copper up to 0.10 mm. thick results in formation of a borided layer under the plate; of a smaller magnitude, however.

Figure 4 shows the microstructure of a sample of steel "50" borided at 950-960°C. for 4 hours following copper plating. Under the copper layer 0.06-0.08 mm. thick, a borided layer is formed which consists of columnar, dendritic crystals penetrating the basis metal to a depth of 0.10 mm. After boriding steel "50" for 4 hours without the preliminary copper plat-

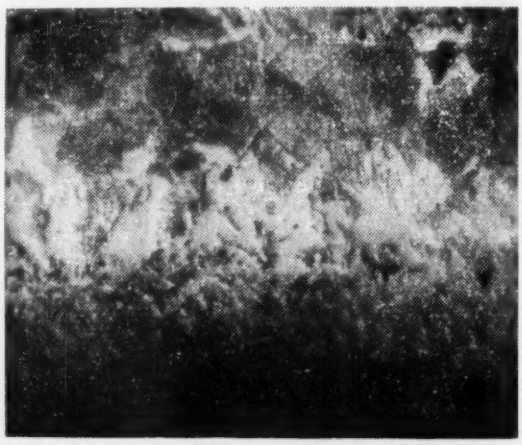


Fig. 4. Microstructure of copper plated sample of steel "50" after boriding for 4 hours at 950-960°C. X400.

ing, the borided layer formed on the surface of the sample was 0.25 mm. thick, i.e., it was 2.5 times thicker than with the preliminary copper plating.

Microhardness of the borided layer formed under the copper plate and measured with a 100 g. load was 1000-1600 kg./mm.^{2}, microhardness of the copper plate was 80-140 kg./mm.^{2} No increase in hardness of the copper layer was observed after boriding.

Figure 5 shows a relationship between the depth of the boron penetration into the steel "50" and the thickness of the copper deposit after boriding for 2 hours at 950-960°C. Increasing the thickness of the copper above 0.1 mm. completely prevents diffusion of boron into the steel.

Microstructural analysis of the specimens of steel "50" borided at 950-960°C. for 2 hours showed that, when the copper layer on the surface of the sample was 0.14 mm., only very insignificant thicknesses of the borided layer could be detected, almost indistinguishable under the microscope; and, there was no indication of boron diffusion through the copper plate 0.17-1.35 mm. in thickness.

Metallographic analysis of the samples copper

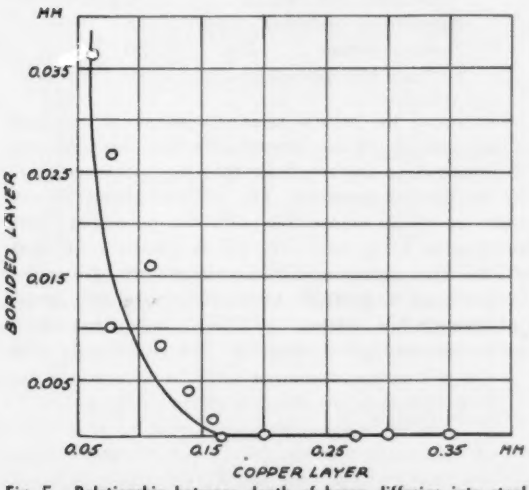


Fig. 5. Relationship between depth of boron diffusion into steel "50" and thickness of copper plate after boriding for 2 hours at 950-960°C.

Fig. 6. Microstructure of copper plated sample of steel "50" after boriding for 2 hours at 950-960°C. X400.

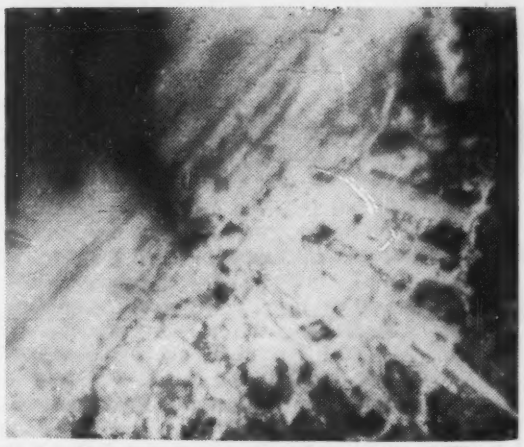


Fig. 7. Microstructure of copper plated sample of steel "50" after boriding for 4 hours at 950-960°C. X400.

plated and borided under different conditions established that the quality of the copper plate (existence of pores, cracks, etc.) has a great bearing on the complete protection of steel from boron diffusion.

The microstructure of a sample borided at 950-960°C. for 2 hours and possessing one local area of low quality copper plate is shown in Figure 6. A borided layer of 0.06-0.08 mm. was formed under the porous copper.

Figure 7 shows the microstructure of a sample subjected to boriding at 950-960°C. for 4 hours following copper plating. Through a crack in the copper plate, boron penetrated into the steel and resulted in formation of a cluster of borides in the form of interlaced, dendritic crystals.

The above data indicate that copper plating can be used for local protection from boriding of nonfunctional surfaces of parts, provided the copper deposit is dense and of a sufficient thickness, without any defects. It is a well known fact that the properties of electrodeposits depend on their structure: the smaller the grain size the higher the density and the hardness of the plate. Increased cathode current density results in increased cathodic polarization, formation of fine-grained deposits and, consequently, in improved mechanical properties. Similar results are produced by the presence of colloidal or surface-active substances in the electrolyte. However, many colloidal and surface-active substances (glue, gelatin etc.) produce brittle copper deposits. Some colloidal substances absorb the electrolyte, thus affecting the structure of the deposits and causing their delamination. When heating such deposits, the evaporating water may cause blisters and rupture of the copper plate.[4] Such occurrences are particularly harmful in the local protection of nonfunctional surfaces of parts from boriding.

The porosity of the copper plate can be checked by using a solution of 10 g./l. potassium ferricyanide and 20 g./l. sodium chloride. The appearance of blue spots (pores) after 2-3 minutes in this solution allows to determine the quality of the copper plate and its usefulness for protection in boriding.

Further experiments were conducted on boriding

(*Continued on page* 53)

Electroless Gold Plating

By S. Duffield Swan, *Technical Director, and*

E. Lamar Gostin, *President, Metal Processing Co., Inc., Cedar Grove, N. J.*

IN recent years, plating by chemical reduction has become increasingly important. The main features of such coatings are 100% throwing power and uniformity of deposits. (Some coatings, like electroless nickel, have additional properties such as very high hardness, and retain their properties at high temperatures.) The current trend toward miniaturization of electronic and missile parts has necessitated the use of gold for certain applications. These include solderability and protection of the various components during some manufacturing operations. The use of electroless gold on such items is ideal because of its throwing power.

After several years of development, electroless gold has reached the point where it can be used for industrial purposes with a considerable degree of reliability. The deposited gold is 993.4 fine, and deposits are bright if the basis metal is highly polished. Heavy deposits tend to become dull, but the softness of the metal permits it to be polished by means of buffing. Preliminary tests have shown that these deposits are more dense than those obtained by conventional methods and, therefore, in a great number of cases thinner deposits will usually do the job.

The electroless gold solutions, like those used for other metals, consist of a gold salt in solution along with a buffer and a reducing agent. A number of different combinations have been tried with varying degrees of success. The following is a bath* which produces good results:

Potassium gold cyanide	2 g./l.
Ammonium chloride	75 "
Sodium citrate	50 "
Sodium hypophosphite	10 "

Control of the bath is relatively simple. It requires adjustments of pH and temperature, and the additions of chemicals to replace those that are consumed during the plating operation. The additive chemicals are made up to be compatible with the particular bath formulation being used. The pH is usually controlled at 7.0-7.5 by additions of dilute ammonium hydroxide. Temperature is by far the most critical item and greatly affects rate. A range of 92°-95°C. is best for maximum rate and good deposits. The following table

*Patents Pending

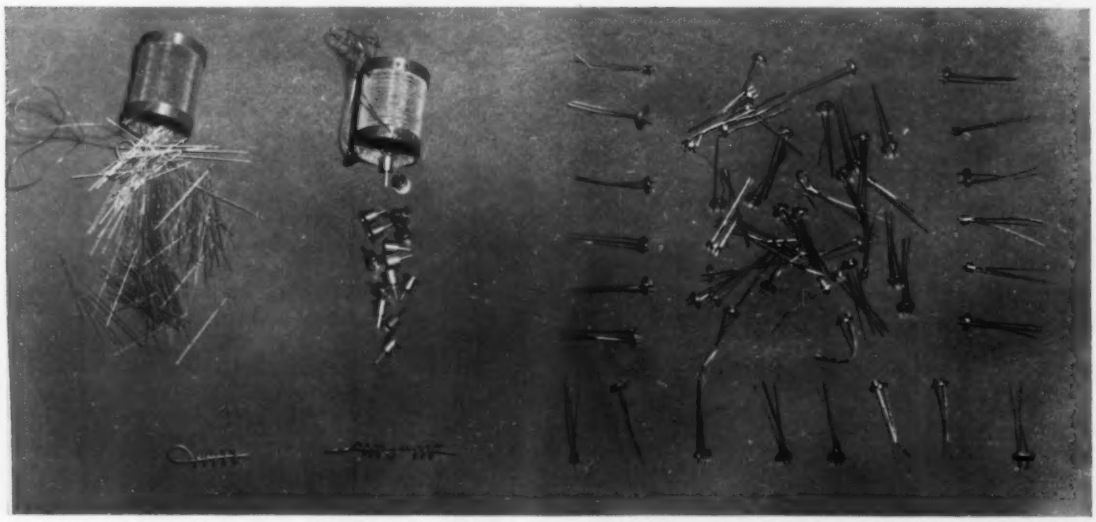
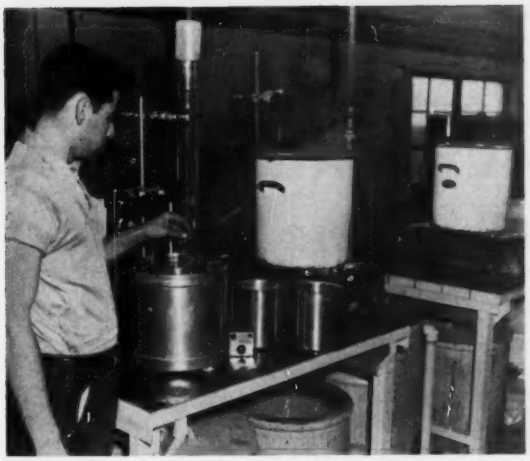


Fig. 1. Various electronic components which have been electroless nickel and electroless gold plated. The coiled wires at the lower left are test panels, with an area of exactly one inch. With these, gold thicknesses can be quickly and easily determined by weighing.



(Courtesy Summit Finishing Co., Thomaston, Conn.)

Fig. 2. Pilot line electroless gold unit in operation. From left to right: Gold plating unit, double activation (two beakers), electroless nickel plating tank, water rinse, alkaline soak cleaner.

shows this relationship, all panels being immersed for a period of one hour:

Temp. °C.	*Number of Test Panels*	*Average Deposition Inch x 10⁻⁶*
91	2	10
91.5	2	17
92	10	37
92.5	13	62
93	17	92
93.5	6	121
94	6	161
94.5	5	188

Deposits heavier than those listed above were obtained by leaving specimens in for longer than one hour. However, the deposition rate during the subsequent periods was not as great as that obtained during the first hour. The apparent reason for this is a build-up of a barrier between the deposited gold and the bath which considerably slows down the deposition rate. With periodic activation, this can be improved considerably. When such a procedure was followed, heavy deposits were obtained over a period of several hours:

A. Short Tests (1-3 hrs.)

Temp.	*No. of Panels*	*1st Hr.*	*2nd Hr.*	*3rd Hr.*	*Total*
92-93°C.	5	.000051″	.000050″	.000053″	.000154″
93-94°C.	5	.000144″	.000139″	—	.000283″
95°C.	5	.000287″	—	—	.000287″

B. Long Tests (Over 5 hrs.)

Period	*Thickness for Period*	*Total Thickness*
First 5 hrs.	.0005″	.0005″
Next 5 hrs. (total 10 hrs.)	.0002″	.0007″
Next 5 hrs. (total 15 hrs.)	.0002″	.0009″

In general, the process is applicable to plating gold on a large group of metals, as well as non-metallic materials. The best results are usually obtained when the gold is put over an undercoating of nickel, particularly electroless nickel. Prior to this, parts should be cleaned in accordance with standard procedures for preparing the various basis metals for plating. In the case of non-metallics, it is necessary to introduce stannous and palladium chloride dips in the line. Figure 1 shows a number of different parts which have been electroless nickel and electroless gold plated. It should be noted that this process is ideally suited for basket or barrel work, as well as items that are complicated in shape.

Stainless steel or glass provide suitable containers for holding the solution. This, in turn, should be heated by an external source, preferably with a water jacket. Mild agitation is necessary, as well as good temperature control. The pH can be maintained by periodic additions of ammonia and the use of pH paper. A system to provide continuous flow of the addition agents is necessary, and the flow is determined by the amount of work being plated. The most satisfactory loading is between 50 and 75 square inches per gallon, but this can vary with the type of parts being processed. Continuous filtration is not necessary, but should be used on larger installations. Smaller units can be run for approximately eight hours and then hand-filtered. The life of the plating bath is comparable to that of other electroless plating solutions. On several occasions, baths have been run as much as 50 hours in the authors' laboratories and, at the end of that time, were still producing good quality gold at reasonable deposition rates. Figure 2 shows a pilot line 2-gallon unit set up to handle samples and establish production procedures for handling parts in the plant. The equipment features mentioned above are amply demonstrated here.

ELECTROPLATED COATINGS IN BORIDING OF STEEL

(Continued from page 51)

of samples made of brass and bronze alloys. Microstructural analysis indicated that neither brass nor bronze are affected by boriding.

Zinc or tin coatings cannot be used for the purpose of local protection in boriding because their melting points are considerably lower than the boriding temperatures. Brass and bronze, however, can be used in this application. It can be accomplished, for instance, by coating nonfunctional surfaces of parts with brass foil, etc.

Conclusions

The use of various electroplated coatings in boriding gives different results. Nickel plated samples form a borided layer of a normal structure. Copper plating prevents boron from diffusing into steel and can be used for the purpose of local protection of nonfunctional surfaces of parts from the formation of the hard borided layer.

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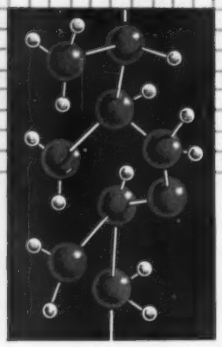


SYNTHETIC RESINS

The Backbone of Modern Finishes

A SURVEY OF THE LATEST DEVELOPMENTS IN SYNTHETIC RESINS USED IN COATINGS

Part VII - Acrylic Resins

By Harold P. Preuss

THE history of the acrylics dates back to 1843 when acrylic acid was first synthesized. By 1900 most of the common acrylates were known in the laboratory and many of the basic factors involved in their polymerization were understood. The potentialities of these resins, however, appear not to have been recognized in those early days. As a result, the first pilot plant for the production of methyl and ethyl acrylates was not built in the United States until 1931.

Chemistry of Acrylic Monomers

The vinyl grouping is common to all acrylic monomers:

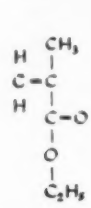
$$CH_2=C<$$

When an acid or carboxyl group is joined to the vinyl radical with an H or CH_3 the products are acrylic or methacrylic acids:

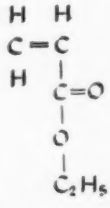
$CH_2=C<^{H}_{COOH}$ Acrylic acid

$CH_2=C<^{CH_3}_{COOH}$ Methacrylic acid

Esterification of the acrylic acids with various alcohol substitutes gives a large group of acrylic esters* with a wide range of properties. Examples are ethyl methacrylate monomer and ethyl acrylate monomer which have the following structures:



Ethyl Methacrylate



Ethyl Acrylate

*Esters are organic compounds corresponding in structure to salts in inorganic chemistry.

The ethyl group in each case is in the ester grouping. If a methyl group is used in each monomer in place of the ethyl group then the monomers are known as methyl methacrylate and methyl acrylate respectively.

Other long chain radicals can also be used in the ester group such as butyl, hexyl, octyl, lauryl and stearyl groups. For protective coatings the lower members of this series with one, two and four carbon atoms corresponding to methyl, ethyl and butyl groups are most widely used.

The side chain length of the monomer used for a particular polymer has a pronounced influence on the physical properties of the resulting polymer. When short side chain groups such as the methyl group are used for the monomer the resulting polymer tends to be hard, tack-free, high in tensile strength and low in elongation. Substitution of longer groups in the side chains results in soft, tacky polymers with low tensile strength and great elongation.

The methyl groups in the methacrylate polymers also have an important influence on the polymer properties. Methacrylate polymers, with ten carbon atoms or less in the ester grouping, are harder, and have higher tensile strengths and lesser elongation than the corresponding acrylate polymers. This increased rigidity is due to the presence of the methyl group on the alpha carbons of the main chain polymers.

All of the acrylic resins discussed in this article belong to Group 5 (Polymeric Esters) mentioned in the first article of this series (June, 1960).

Acrylic Solution Polymers

The first of the acrylic resins to be exploited for commercial purposes were the solution polymers. Although thirty years have elapsed since these first products were made available, many of the solution polymers sold today are very much the same as the first products made.

Acrylic ester polymers for organic solution coatings are commonly prepared either by bulk polymerization or by solution polymerization. In the bulk polymeriza-

tion method the desired monomers are polymerized in the presence of catalyst to produce solid polymers. These solid polymers are then broken in a crusher to small lumps and supplied to the paint manufacturer in that form. The chief advantage of the solid acrylic polymer is that the paint chemist has wide latitude in the choice of solvents used for the system. The solid polymers are usually dissolved in a shellac cutting barrel or high speed impeller type mill. However the solid polymers are relatively difficult to dissolve so that similar polymers in solution are often preferred.

These may be conveniently prepared from suitable acrylic monomers by using the desired solvent as a diluent in the reaction. This method is particularly convenient because it is easy to control the rate of reaction and the final polymer may be filtered, pumped and handled as any other paint vehicle. This method is particularly suited for the production of polymers with low and medium molecular weights. Very high molecular weight polymers are difficult to prepare by solution polymerization since they give very high solution viscosities.

The major uses for the acrylic polymers in organic coatings depend largely on the following properties available in these resins:

1. Transparent water-white films.
2. Resistance to discoloration from high temperatures, and ultraviolet light.
3. Resistance to water, alkali, acids and oils.
4. Minimum pigment reactivity.
5. Good resistance to burning.
6. Resistance to chemical fumes.
7. Long film life and flexibility under rugged outdoor exposures.
8. Good electrical properties.

Most of these polymers are thermoplastic in nature and are permanently soluble in suitable organic solvents.

Organic solutions of acrylic polymers are handled in much the same way in the paint plant as are other solution vehicles. They may be used as clear finishes alone or with other modifiers or they may be pigmented with most conventional paint pigments due to their low pigment reactivity.

Relatively strong solvents are usually used for thinning acrylic paints. Some of these paints permit the use of xylol or toluol while others require ketone solvents such as methyl ethyl ketone. A few specialized acrylic coatings, chiefly for brush application, may be thinned with mineral spirits or turpentine. Strong solvents may lift previous coats of conventional paints so that special primers are often required.

Acrylic coatings may be either air dried or baked. No oxidation is needed to form the films since they dry by solvent evaporation. This places these coatings in the category of the fast drying lacquer-type coatings.

Acrylic solution polymers are also available where the solvent is water. The polymers may be heat activated resins or the permanently water-soluble type. In the thermosetting resin field an example would be American Cyanamid's Melaqua 600 (see later description). Such a resin may be considered in high gloss, high durability applications, as for example in automotive topcoats. It may also find utility in appliance coatings and metal primers.

Acrylic Emulsion Polymers

An emulsion polymer may be defined as a reasonably permanent suspension, by use of a surface active agent, of minute particles of polymers in a water medium. In making an acrylic emulsion polymer, the acrylic monomer is added directly to the water with other necessary ingredients and polymerization takes place in the water medium. The acrylic monomers commonly used are ethyl acrylate, methyl methacrylate, and acrylonitrile. Vinyl acetate is also commonly used in combination with one of the above. Other monomers, as well as inhibiters, are used to modify the polymers in special ways. Catalysts, such as water-soluble peroxides, speed the reaction and result in higher molecular weight polymers. Surface active agents are added to break up the monomer into tiny globules, to keep these globules in suspension, later to prevent partially polymerized globules from coagulating, and still later to prevent fully polymerized particles from settling to the bottom of the container, etc. The surface active agents generally consist of sodium or ammonium sulfates or sulfonates of fairly long-chain hydrocarbons.

The emulsion polymerization of the acrylic esters can be carried out either with a reflux system with a persulfate or peroxide catalyst or with a redox* catalyst system. The redox systems offer the advantage of not requiring the application of heat to initiate the polymerization reaction. This usually results in the production of high molecular weight polymers. Since acrylic polymerizations are all highly exothermic, monomers are added to the batch slowly.

Acrylic emulsions may be used in finishing leather, paper, textile, etc. However, their greatest use is in emulsion paints. Paints made from acrylic dispersions possess good color retention, toughness, flexibility and adhesion. The acrylic polymer does not oxidize and does not become yellow or brittle on aging. Manufacturers of acrylic emulsion paints recommend them for use on many different surfaces. For interior work, the paints are particularly well-suited for walls and ceilings made of plaster, wallboard, cinder block and cement. Acrylic emulsion paints have given outstanding service outdoors on masonry structures which are normally difficult to paint because of their porosity and high alkali content. Resistance to blistering caused by moisture in the walls is very good, because, as mentioned earlier, the acrylic film transmits water vapor, but resists rain water. The polymer is inherently resistant to mildew. Outstanding durability has been obtained on stucco, concrete, cinder block and Masonite.

Over the past seven years extensive exposure tests have been made of acrylic emulsion paints applied to exterior wood surfaces. In addition to thousands of exposure panel studies, test projects have also been made of hundreds of buildings on which these paints have been used in commercial application. Such paints will withstand blistering heat from the sun; battering rain, sleet and snow; exposure to fume-filled atmosphere; and the erosive effect of wind-driven grit.

*Redox is a contraction of "reduction-oxidation." The oxident used is the normal persulfate catalyst, and the reducing agent that serves as the activator is usually a sulfaxy compound or a small amount of ferrous salt.

Water base paints are not recommended for use directly on bare wood where the fibers would "drink up" the water carrier too fast to permit the film to form properly. On such surfaces, the use of special oil primers to prepare the surface is commonly recommended by manufacturers. Such primers are also suggested on previously painted surfaces which are in bad condition after the excessive chalking or other loose paint has been removed.

Manufacturers of Acrylic Resins

A number of firms in the United States manufacture acrylic monomers. Since these are not usually of direct interest to the paint formulator, they will not be discussed in this article. Suffice it to say that these acrylic monomers when polymerized to make homopolymers or copolymers with other monomers such as styrene, vinyl chloride, vinyl acetate, etc., impart outstanding properties to finished protective coatings. These properties include improved weatherability, increased resistance to heat and light, improved adhesion, greater water and chemical resistance, improved glass and gloss retention, and improved color retention.

The acrylic resin polymers and copolymers for use in formulating protective coatings, discussed in this article, are made in the United States by the following firms:

Allied Chemical, Plastics and Coal Chemicals Division, New York 6, N. Y.
American Cyanamid Co., Plastics and Resins Division, New York 20, N. Y.
The Borden Co., Chemical Division, New York, N. Y.
Celanese Corporation of America, Newark, N. J.
Dow Chemical Co., Plastics Department, Midland, Michigan
E. I. DuPont de Nemours & Co., Inc., Polychemicals Dept., Wilmington, Del.
B. F. Goodrich Chemical Company, Cleveland, Ohio
The Goodyear Tire and Rubber Co., Chemical Division, Akron 16, Ohio
Monsanto Chemical Co., Plastics Division, Springfield, Mass.
Reichhold Chemicals, Inc., White Plains, N. Y.
Rohm and Haas Co., Philadelphia, Pa.
U.B.S. Chemical Co., Division of A. E. Staley Mfg. Co., Cambridge, Mass.
Union Carbide Plastics Co., New York, N. Y.

Table 1 lists the properties of the acrylic coating resins made by the above firms.

Allied Chemical

Allied produces two acrylic alkyd copolymer coating resins, known as *PR-287* and *PR-268*.

PR-287 is an acrylic-alkyd copolymer resin supplied as a solution. This product is especially adaptable to roller coating work where control of solvent evaporation is critical. It can be utilized in coatings for post-formed bottle caps and strip metal applications where excellent adhesion, toughness, chemical and boiling water resistance are requirements. Enamels based on PR-287 also have good flexibility and resistance to impact and excellent exterior durability. The resin is stable and does not haze during storage at low temperatures. Other suggested uses include protective coatings for containers, advertising signs and exterior awnings.

PR-268 is an acrylic-alkyd copolymer resin supplied as a solution in xylol. Very fast air drying or baking finishes in both clear and pigmented systems are possible with this resin. High gloss films can be formulated with this resin that exhibit excellent adhesion (especially to copper and aluminum), good flexibility, unusually good durability, chemical resistance and color retention. It is suggested for use in finishes for appliances, industrial equipment, advertising signs and automotive refinishing.

American Cyanamid

The Plastics and Resins Division of American Cyanamid manufactures an acrylic polymer cross-linked with melamine resin which they call *Melaqua Resin 600*. This is a completely water-soluble, heat-convertible vehicle for the formulation of industrial baking enamels. Melaqua Resin 600 enamels are superior in some respects to the highest quality melamine resin-non-oxidizing alkyd formulations. Nothing but pigment and water need be added to the vehicle to produce a ready-to-spray enamel, so that high performance is obtained plus complete freedom from the hazard of flammable organic solvents.

Borden

This company produces a copolymer of two acrylic monomers known as *Polyco 413*. Films of this polymer do not discolor at high temperatures and exhibit good water, alcohol and acid resistance. The films also show good resistance to mineral and vegetable oils and grease. Polyco 413 is used in lacquer, vinyl printing inks and top coatings for vinyl coated fabrics, papers and metals.

Under the trade name *Arcco*, Borden also supplies a vinyl-acrylic copolymer paint system for the protection of metal and masonry surfaces. These finishes possess good resistance against the corrosive action of chemicals, fumes and salt water, and find applications in maintenance, manufacturing and construction projects.

Celanese

This firm markets a vinyl-acrylic emulsion known as *CL-203*. Films prepared from this emulsion are characterized by good clarity, flexibility, resiliency and lack of discoloration when exposed to heat and light. They are resistant to water spotting, may be heavily pigment loaded and are grease resistant. Emulsion CL-203 may be used as a vehicle for interior flat, semi-gloss and gloss, primer sealer, exterior and specialty formulations as well as for industrial primers and finishes. Important properties such as good flow, color and sheen uniformity, borax stability, washability and flexibility are imparted to paints formulated with this emulsion.

Celanese also makes an acrylic type tripolymer emulsion, known as *VX-551*, developed for use in paint, textile and specialty coating applications. As a paint binder, VX-551 is comparable in physical properties to other acrylic emulsions commercially available. Weatherometer exposure tests show it to have considerably better tint retention and durability compared to other acrylics.

TABLE 1

PROPERTIES OF ACRYLIC COATING RESINS

MANUFACTURER	RESIN	PHYSICAL FORM	% SOLIDS	SOLVENT	VISCOSITY, CPS @25°C (BROOKFIELD)	SP. GR. @ 25°C.	pH	HARDNESS ROCKWELL R	COLOR
ALLIED CHEMICAL	PR-287	SOLUTION	50±1	"SOLVESSO 150"	1000-2300	0.99	—	—	3.7 ⑦
	PR-268	SOLUTION	50±1	XYLOL	550-1000	0.97	—	—	2-4 ⑦
AMERICAN CYANAMID	MELAQUA 600	SOLUTION	50±2	WATER	7000-15000	1.09	9.5-10.0	—	7 MAX. ⑦
BORDEN	POLYCO 413	SOLUTION	40	MEK	1200-1500	0.96	—	—	CLEAR
CELANESE	CL-203	EMULSION	55	WATER	2200±300	1.1	4.5±0.5	20 ②	—
	VX-551	EMULSION	46±1	WATER	50-200	1.06	6.5-7.5	—	—
DOW	LATEX 2647	EMULSION	47±1	WATER	13-14 ⑦	1.07-1.08	8.5±0.5	—	WHITE MILKY
DU PONT	LUCITE 41	SOLID	100	—	950-1600 (17½% SOLN IN TOLUENE)	1.19	—	124	WHITE
	LUCITE 42	SOLID	100	—	0.849-0.986 (INHERENT)	1.12	—	116	WHITE
	LUCITE 44	SOLID	100	—	40-70 SEC ① (43% SOLN IN TOLUENE)	1.06	—	-152	WHITE
	LUCITE 45	SOLID	100	—	40-70 SEC ① (35% SOLN IN TOLUENE)	1.05	—	112	WHITE
	LUCITE 46	SOLID	100	—	40-70 SEC ① (40½% SOLN IN TOLUENE)	1.05	—	88	WHITE
GOODRICH	GEON 450X3	EMULSION	52-54	WATER	20-50	1.12-1.14	6.5-8.0	—	—
GOODYEAR	PLIOLITE AC	GRANULES	100	—	—	1.04	—	—	WHITE
MONSANTO	LYTRON 680	EMULSION	46-48	WATER	20-110	1.018-1.02	9.0-9.5	—	WHITE
REICHHOLD	SYNTHEMUL 40-401	EMULSION	46±0.5	WATER	1000±500	1.06-1.08	8.5-9.5	—	WHITE MILKY
	SYNTHEMUL 9402	EMULSION	39-41	WATER	40-100	1.02-1.07	8-9	—	—
ROHM AND HAAS	ACRYLOID A-10	SOLUTION	30±1	CELLOSOLVE ACETATE	710-850 ⑤	1.03	—	—	—
	ACRYLOID A-101	SOLUTION	40±1	MEK	700-1500 ⑤⑥	0.94	—	—	—
	ACRYLOID B-44	SOLUTION	40±1	TOLUOL	600-1100 ⑤	0.97	—	—	—
	ACRYLOID B-66	SOLUTION	40±1	TOLUOL	250-335 ⑤	0.97	—	—	—
	ACRYLOID B-72	SOLUTION	40±1	TOLUOL	480-640 ⑤	0.97	—	—	—
	ACRYLOID B-82	SOLUTION	40±1	TOLUOL	480-640 ⑤	0.97	—	—	—
	ACRYLOID C-10LV	SOLUTION	40±1	TOLUOL	40-80 ⑤	0.97	—	—	—
	ACRYLOID F-10	SOLUTION	40±1	MINERAL THINNER: ANSCO F	1500 ⑤④	0.91	—	—	—
	ACRYLOID AT-50	SOLUTION	50	60% XYLOL, 22% BUTANOL, 18% CELLOSOLVE	700-1500	1.0	—	—	50 MAX. ③
	ACRYLOID A-21	SOLUTION	30±0.5	90% TOLUOL 10% BUTANOL	250-380	0.94	—	—	CLEAR
	RHOPLEX AC-33	EMULSION	46-47	WATER	—	1.02-1.06	9.0-9.5	—	WHITE MILKY
	RHOPLEX AC-55	EMULSION	49.5-50.5	WATER	—	1.08	—	—	WHITE MILKY
	RHOPLEX AC-200	EMULSION	46±1	WATER	—	1.1	9.0-10.0	—	MILKY
UBS	UBATOL U-7001	EMULSION	50±1	WATER	1000 MAX.	1.059	5-6	—	—
UNION CARBIDE	WCX-140	EMULSION	54-56	WATER	200-500	1.08-1.09	4.4-5.0	—	—

① VISCOSITY BY No. 15 PARLIN CUP. ② SWARD HARDNESS. ③ APHA.
④ CONTROL = 85-110 CP AT 25% SOLIDS. ⑤ VISCOSITY AT 30°C. ⑥ AT 35% SOLIDS.
⑦ GARDNER, 1933.

Dow

The Plastics Department of The Dow Chemical Company manufactures an acrylic latex sold under the name *Latex 2647*. It is designed primarily for use in paints for exterior wood and masonry finishes. Among its chief attributes are extremely good exterior weathering and water resistance. This type of latex has found some utility in metal coatings, both air dried and baked. It has also been used for decorative and functional coatings in textile, paper, and building products applications. The scrub resistance of Latex 2647 is excellent. Paints exhibit resistance to discoloration and embrittlement caused by exposure to heat and light. They have also demonstrated excellent film formation when applied at 42-48°F. (48% R.H.).

DuPont

The Polychemicals Department of E. I. DuPont de

Nemours and Co. produces five acrylic resin methacrylate polymers for use in protective coatings under their general *Lucite* trademark. All are in the form of granular solids and bear the numerical designations *41* (methyl methacrylate), *42* (ethyl methacrylate), *44* (n-butyl methacrylate), *45* (isobutyl methacrylate) and *46* (50/50 copolymer n-butyl/isobutyl methacrylate). They find use in the following industries:

Electrical: Laminating varnishes for insulation . . . coatings for electroplating racks, coils, condensers, etc. . . . stop-off lacquers in electroplating. Temporary coating for deposition of phosphors in television tubes.

Finishes: Clear lacquers . . . ingredients in wide variety of lacquers, varnishes, paints, enamels and plastic sprays, including over-print lacquers, sealer coats, fluorescent and vinyl resin type finishes.

Glass and Ceramics: Coatings for optical lenses and goggles . . . impregnants and binders for glass fiber mats. Safety coating for flash bulbs. Glazing adhesives.

Inks: Ingredients in gravure, flexographic and silk screen inks.

Metals: Protective coatings . . . wire-coating enamels, metal foil adhesives, sealing compounds, automotive chrome lacquer, ingredient in investment casting compositions.

Chemical properties of these resins include the following:

STABLE to sunlight and aging under many conditions of exposure . . . stable at temperatures up to 250 to 300°C., at which point slow depolymerization begins.

RESISTANT to dilute solutions of strong acids and alkalies, petroleum oils, aliphatic hydrocarbons, and dilute alcohols.

NOT RESISTANT to concentrated alkalies and oxidizing acids, the lower ketones, esters, aromatic and halogenated hydrocarbons, and lacquer thinners.

Goodrich

Geon Latex 450X3 is the trade name given by the B. F. Goodrich Chemical Company to its vinyl chloride-acrylic copolymer. This product provides a cohesive and adhesive paint film exceptionally resistant to weathering. It has outstanding durability in paints for wood and masonry. The well known toughness, chemical resistance and weatherability of polyvinyl chloride are maintained in paint films made from this resin. The acrylic comonomer keeps the film flexible throughout the long life expected of paint. Paints made with Geon 450X3, even at the low pigment volume concentrations necessary for self-priming over wood, exhibit no tack and show great resistance to dirt pickup. Water will not penetrate but moisture from the building interior can escape through the paint film.

Goodyear

The Chemical Division of Goodyear makes a styrene/acrylate copolymer paint resin which they call *Pliolite AC*. It is readily soluble in low-cost industrial solvents. Solutions of Pliolite AC dry rapidly to form tough, hard films which adhere well to a variety of substrates. Characteristic properties of the resin include outstanding resistance to chemicals, ultra-violet light and water. It is suggested for use in such applications as: masonry paints, industrial maintenance finishes, concrete enamels, swimming pool paints, traffic marking paints and multicolor finishes.

Monsanto

Lytron 680, made by Monsanto, is an acrylic latex made from a combination of monomers to produce a material which will form a film at temperatures less than 40°F. (5°C.) without modification. Films cast from Lytron 680 have great flexibility and resistance to oxidation on weathering. The latex is supplied at a pH of 9.0 to 9.5 which allows the use of a wide variety of pigments and surface active agents. It offers a highly effective binder for exterior latex paint, for interior latex paint and for certain industrial applications where very high pigment loading is required.

Reichhold

Two acrylic type resins are marketed by Reichhold Chemicals, Inc. under the trade name *Synthemul*.

Synthemul 40-401 is a latex of very fine particle size. This acrylate ester copolymer latex deposits tough, flexible films of brilliant clarity and water-whiteness. The films resist discoloration and degradation by ultra-violet light, and are resistant to moisture and alkali. Intrinsic flexibility, independent of any added plasticizers is conferred by the molecular structure of the selected comonomers in this resin. The ease with which it forms coherent and adherent films recommends it for a broad variety of interior and exterior paints, leather and paper coatings and for numerous versatile binder specifications.

Synthemul 9402 is a fine particle sized acrylate ester latex copolymer depositing soft, flexible, highly adherent films of acrylic resin, whose pigment binding properties and toughness are well suited to preparation of coatings. Compatibility with both natural and other synthetic products further enhances its usefulness in this application.

Rohm and Haas

The Resinous Products Division of Rohm and Haas Company manufactures a family of solution resins under the trade name *Acryloid*. These are polymers of esters of acrylic and methacrylic acids. Related polymers are widely used in plastic sheet, moldings, and emulations for paint vehicles, for textile treatment, and for leather finishes. Excellent outdoor durability, water-white color, lack of discoloration on aging and exposure, and chemical inertness are the outstanding characteristics of the Acryloid resins. They are used in both air-drying and baking finishes. The films are permanently soluble in organic solvents and will resoften at high temperatures. Maximum gloss and adhesion are obtained by baking at moderate temperatures. Table 2 summarizes the characteristics and uses of the ten Acryloid resins. Use of these resins has

TABLE 2

Characteristics and Uses of Acryloid Resins

A-10	Hard, resistant to alcohol and water. Used for heat-resisting white enamels of extremely light color and excellent color retention.
A-101	Made from same polymer as A-10, but supplied at 40% solids in methyl ethyl ketone. Used in vinyl printing and solution coating operations.
B-44	Low viscosity solution for clear and pigmented finishes. Intermediate in hardness and flexibility between A10 and B-72. Excellent adhesion. Especially useful in automotive refinishing, aircraft finishes, and general purpose lacquers in which maximum durability, color retention and adhesion are required.
B-72	Low viscosity solution for clear and pigmented finishes. Excellent flexibility. Used for fume-proof enamels, fluorescent coatings, cloth coatings, and aerosol finishes.
B-82	Properties and uses are similar to B-72. Available at lower cost.
B-66	Similar in most properties to B-72 and B-82 but slightly harder and faster in solvent release.
C-10LV	Extremely flexible resin used as a base coat for adhesion on textiles. With nitrocellulose, is used in high grade artificial leather coatings. Used in rubber lacquers.
F-10	Soluble in petroleum hydrocarbons, good adhesion, high elongation. Used for clear and pigmented coatings on metal, fumeproof enamels.
At-50	Good solvent resistance, resistance to printing and to deformation at elevated temperatures. Useful in finishes for appliances, metal furniture, hospital equipment, stoves, drums, etc.
A-21	Possesses excellent adhesion, hardness and outdoor durability. Useful for automotive finishes, for metal signs, appliances, furniture, heaters and metallized plastics.

also extended to specialty applications, such as heat resistant enamels, luminescent and phosphorescent coatings, fume resistant enamels, etc. All of the resins listed in Table 2 are available as a solution in various organic solvents, but in addition resins B-72, B-82 and B-66 are also available as 100% solids.

This company also makes three aqueous emulsions of acrylic polymers under the trade names *Rhoplex AC-33, Rhoplex AC-55* and *Rhoplex AC-200*. Rhoplex AC-33 is a non-ionic emulsion; Rhoplex AC-55 is anionic. Both are moderately viscous and show excellent storage stability. Tests which have been conducted over a period of years show that the emulsions can be frozen and thawed without effect upon their paint-making properties. They are also resistant to hard water or to materials containing soluble salts added during manufacture. Both emulsions dry rapidly by evaporation of water to give tough, flexible films with excellent pigment binding properties. These find usage in exterior coatings on stucco, cinder block, concrete, asbestos shingles and other masonry surfaces. They have also been used extensively on wood surfaces. Rhoplex AC-33 polymer is tough, adherent, flexible, color-retentive and resistant to ultra-violet light, alkalies and moisture. It is the older of the pair, and has been successfully field tested over a seven year period. Rhoplex AC-55 provides wide latitude in the formulation of durable exterior and interior emulsion coatings. It also provides maximum color development in colored paints and tint bases.

Rhoplex AC-200 is an aqueous emulsion of an acrylic polymer for baking finishes. It converts on baking to extremely hard, glossy films possessing exceptional water, chemical, and humidity resistance, adhesion and impact resistance. In addition, it has the properties characteristic of the acrylic polymers, particularly excellent color and color retention, stability and durability. It is suggested for use in top coats and primers for appliances, automobiles, steel drums, machinery, motors, metal furniture and other applications in which baking finishes are utilized.

U B S

U-7001 UBATOL is an acrylic co-polymer emulsion manufactured by the U B S Chemical Company. This latex forms a hard, dry, glossy, water-resistant film upon simple air-drying. It can be formulated into interior water-reducible non-yellowing paints with superior properties including gloss retention in the dried film. Opacity of the dry paint film at the pigment volume concentrations used is outstanding. Flow, leveling and viscosity stability are comparable to many gloss paints formulated with alkyds. They have good compatibility with color pigments and color systems. Stain removal and water resistance properties are excellent. Formulations based on this resin have been used as architectural gloss and semi-gloss interior paints as well as on unprimed steel surfaces.

Union Carbide

The Union Carbide Plastics Company produces a vinyl acrylic latex known as *Bakelite Latex WCX-140*. This is an internally plasticized dispersion which produces films of excellent clarity, gloss, flexibility, and water-spot resistance. The high filming potential of this latex emulsion results in superior low temperature filming and high pigment binding ability. It also possesses good mechanical, thermal, and electrolyte stability. Paints compounded with this latex also demonstrate good adhesion, heat and freeze-thaw stability, flow, leveling and brushability. Examples of coatings prepared from WCX-140 include semi-gloss enamels, wallboard primer-surfacers, flat wall paints, exterior masonry paints, and baking coatings for metals.

Summary

It is not possible within the scope of one article to cover all of the ramifications of the acrylic family of products. A number of polymers have potentials in a variety of fields. There exists a group of thermosetting coating applied from solvent systems, some alkyd, oil or epoxy modified, which show great promise in

the appliance industry because of their high gloss, color retention, chemical resistance, and their potential use as one-coat enamels. Examples of these are Duracron (Pittsburgh Plate Glass), Super Nubelite (Glidden Co.), and Lucite (DuPont). Some copolymers are available which embody so small a quantity of acrylic resin as to hardly qualify them for description here; an example of this would be National Starch and Chemical Corporation's Resyn 2243. Other acrylic polymers have not been discussed here because their applications are in fields unrelated to the scope of this magazine, such as textile sizing; an example of such a resin is Neocryl S21B made by Polyvinyl Chemicals, Inc.

Acrylic emulsion paints constitute a major expanding development. Specifically recommended for durability of finish, lack of odor, speed of drying, and ease of application, the use of both the emulsion and compounded paints for interior and exterior use in pigmented formulations is being expanded. Some formulations have been suggested for use over damp surfaces. Exterior use over masonry represents one popular application. Acrylic automotive finishes are a growing field; enhanced durability and prolonged retention of luster are achieved, particularly with pastels.

For application by either spraying or brushing, acrylic coating solutions in organic solvents are available in types that give almost any desired range of hardness or tackiness, with clarity and durability a prominent feature. These acrylic coatings are for both decorative and protective uses, the scope of application ranging from protection of art treasures to resin treatment of raincoats. Decorative and metalized coatings can also be applied to plastics articles to enhance their appearance.

Another family of resins which has shown great promise, and which are also supplied largely in emulsion form, is the styrenebutadiene latex group. These resins will be discussed in the next article in this series.

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MICROHARDNESS OF SILVER DEPOSITS

(*Continued from page* 44)

As the thickness of the deposit increases, the hardness value decreases initially rapidly and then more slowly, thereby indicating gradual elimination of the influence of the basis metal, until, at a thickness of 0.35 mil. and above, the influence of the basis metal is completely obliterated.

Experiments with brass as basis metal (Table III) have shown that a thickness of the same order is absolutely essential.

TABLE III

	Silver deposit over Brass			*Brass*	
No.	*Thickness (mil)*	*Diagonal of indentation (μ)*	*Micro-hardness (Kg/mm²)*	*Diagonal of indentation (μ)*	*Micro-hardness (Kg/mm²)*
1.	0.38	23.6	82	20.3	110
2.	0.36	23.8	80	22.1	93

Summary and Conclusion

Determination of microhardness of silver plate is of considerable value in assessing its usefulness, and even in the control of the baths. Such measurements are beset with many difficulties which are pointed out, and how these could be overcome are discussed. The determination of microhardness has been carried out with silver plates obtained from a low cost combined cyanide-nitrate bath. Experiments carried out with electroplates of varying thickness have shown that a minimum thickness of 0.00035 in. of silver electrodeposit is essential, in order to obtain a microhardness value (at a load of 24.5 g.) irrespective of the basis metal. The load chosen is in accord with practice elsewhere.

Acknowledgement

Thanks are due to Prof. K. S. G. Doss, Director, Central Electrochemical Research Institute, Karaikudi-3 (South India), for his keen interest and helpful criticism in the progress of the investigation.

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Production of Coated Aluminum

By James S. Nelson

KAISER Aluminum & Chemical Corporation, has entered the nation's burgeoning painted aluminum market with a fully integrated production line at its Ravenswood, West Virginia Works. The installation consists of an ore-to-finished-metal operation and a new roll-coating facility turning out painted coil at the rate of 100 feet per minute.

The facility includes two lines: an 18-inch line and a 66-inch line, both capable of painting two sides of a strip different colors simultaneously. The 66-inch line is the widest currently in operation in the nation.

Since last December, this duo of automatic, strictly controlled reverse roll-coating lines have been turning out painted aluminum coil for a variety of rapidly growing end uses — all of it moving on "the premise of the all-purpose."

Essentially this premise has to do with a value judgment of markets — a judgment which admits there is no single finish which is best for all applications, but stipulates there *is* a single finish, given the proper method and rigid enough quality controls, that *is* applicable to a majority of operations — a finish which weds the best possible combination of exterior durability and formability; and hence, a product for mass market.

The need for mass market service has become increasingly self-evident as mushrooming construction and rapidly developing new applications demanded a versatile painted aluminum product, particularly in unusual widths. Most lines now operating are essentially specialty lines, i.e., lines painting a specific product for a specific end use. The Ravenswood lines, however, are shooting for a versatile product with wide application possibilities.

Conceived and designed as basically all-purpose lines, the Ravenswood product is adaptable to all present conventional forming methods, including bending, brake and roll forming, crimping, blanking, and flattening — without damage to the finish.

This product versatility was achieved by (1) built-in automatic cycles providing continuous quality control, and (2) the adoption of a standard quality paint providing the necessary balance of characteristics for formability and durability.

The decision to utilize roll-coating as the production method was realistically dictated by the inherent virtues of the process itself. Of all the various coating techniques, none surpass roll-coating for uniform paint application thickness (a vital point to fabricators). The process lends itself ideally to rigid quality controls, and with paint the largest single cost factor in coating, roll-coating's 95 to 98 per cent paint utilization performance compared with roughly 70 per cent utilization in a good spray operation and approximately 90 per cent in flow-coating, recommended the process ideally for a competitive quality product.

After exhaustive testing and study, Kaiser settled on thermal setting acrylic for its general product line paint, thus becoming the first major producer to announce use of TSA as a standard paint. Tests showed TSA to possess the two major attributes necessary to the pursuit of an all-purpose product — the best characteristics for exterior durability, plus a good balance

Fig. 1. Capable of coating two sides of an aluminum strip different colors simultaneously, the Ravenswood 66-inch line is the widest currently in operation in the industry. This photo shows the line's double-turret pay-off equipment, entry accumulator, and pre-treat tanks. Enclosed paint room is located beyond pre-treat tanks. Strip moves in sequence through these operations then to bake and terminal equipment located beyond the paint room at a rated speed of 100 feet per minute.

of characteristics for formability. Although the lines handle vinyl and epoxies, these are considered basically specialty paints.

Quality control, of course, became the major consideration after decisions on method and standard paint were reached. As a fully integrated facility, quality control of the Ravenswood paint line product actually begins in the Ravenswood Reduction Plant. Here alumina is converted to primary aluminum in a 145-thousand ton rated annual capacity reduction plant. The molten aluminum is cast into ingots, and the ingots rolled into sheet, plate, or foil in a mammoth fabricating plant. An even dozen quality checks later, after the metal has been produced in the proper alloy, rolled to the desired gauge and tested for conformance to prime metal specifications, it is ready for the roll-coating facility. There it will undergo thirteen quality checks before being packaged for shipment to the customer.

Once in the roll-coating facility, automation and built-in control features become the word as coils unwind into the three-step operation. Physically capable of operating practically non-stop twenty-four hours a day, the lines handle coil at 80 feet per minute (small line) to 100 feet per minute (wide line) in widths from ¾ to 66 inches and in gauges from .006 to .064. The entire facility includes twenty-eight individual pieces of equipment, including auxiliary equipment for slitting, shearing, and embossing, in addition to the preparation, painting, and baking equipment (Fig. 1).

Both lines operate essentially the same, utilizing three distinct steps: preparation, coating, and baking.

Preparation of metal for the 66-inch line takes place in a 90 foot long rectangular tank which cleans and chemically coats the unwinding coil in a non-stop operation.

The spray applicator tank is divided into five stages, with the individual stages performing these functions:

Stage 1 — a hot spray non-etching alkaline type cleaner is applied at 150-170 degrees F. through an approximate 20-second cycle.

Stage 2 — a hot water spray at 130 to 140 degrees F. through an approximate 5-second cycle with water purity controlled by a continuous overflow mechanism.

Stage 3 — a chromate conversion coating applied at 90 to 110 degrees F. through a 10 to 15-second cycle. Concentration of the bath is controlled by a proportioning pump feeding liquid chemicals into the spray tank. Bath purity is controlled by continuously processing a portion of the bath through an ion exchange unit.

Stage 4 — a cold water rinse with a 5-second cycle using continuous overflow.

Stage 5 — an acidulate rinse at 130 to 140 degrees F. through a 5-second cycle with bath controlled by the make-up of the solution and by proportionate overflow.

As the strip travels through each stage, the various solutions are sprayed onto both sides, then drained back into their respective tanks. Rubber-covered squeeze rolls, pivotally mounted to avoid tracking problems and pressure adjustable to the traveling strip, are located between each stage, preventing carry-over of a solution from one stage to another.

Stage 3 is the most critical of the preparation tanks, for it is here that the chemical coating for improved paint adhesion is applied. Although quality control features are built into each stage, the stage receives three special analytical tests hourly. Stages 1 and 5 receive two analytical tests hourly with a total of seven special tests made hourly in the three stages.

After leaving the spray applicators, the metal enters a strip-drying unit where it is dried by high-velocity air, then proceeds in a Z-shaped path to the actual painting mechanism. The Z-shaped path was designed to provide cooling time prior to the metal's entry into the coating room. Room temperature strip is desired to prevent major viscosity changes in the coating material.

As insurance against both fumes and paint soilage, the actual roll-coating mechanism is enclosed in a room of its own with thermostatically controlled filtered air being used to maintain a positive pressure in the room and thereby minimize the potential of dust contamination (Fig. 2).

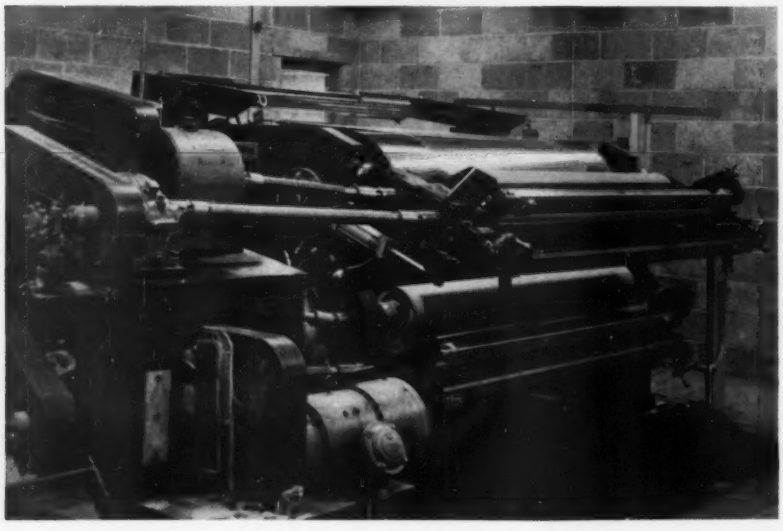

Fig. 2. As insurance against fumes and paint soilage, the roll-coating mechanism is enclosed in a room of its own. Strip enters from beneath the floor, travels an S-path around two large rolls, then proceeds to the bake-out area. Thermal setting acrylic is the standard paint product. The coated strip is adaptable to all present conventional forming methods. By utilizing three coating heads, one side color changes can be made on the move without loss of film continuity.

Fig. 3. Baking takes place in this three stage drying oven. (left) Basically a 100-ft. chamber separated into three stages, the oven is gas-fired with temperature controls in each stage. In general, a one-minute total bake is normal at temperatures of 250°F. in the first stage, 450°F. in the second stage, and up to 650°F. in the third stage. Terminal equipment (right) then takes over.

Paint for the operation is received in 55-gallon drums and is checked by plant personnel against laboratory standards by batch numbers before being released to the paint line. Once released, it is agitated and reduced to operating viscosity, then pumped with air pumps from drums directly into the lines' paint reservoir. Here it is picked-up by a chrome-plated steel roll and metered to a rubber applicator roll for controlled application to the strip.

Entering the roll-coating room from beneath the floor, the strip travels upward in an S-path around two large rolls, then proceeds to the bake-out area. As it passes the uppermost roll, paint is applied by a small diameter applicator roll traveling in reverse direction to the strip. As the strip leaves the coater, the opposite side passes over a second applicator roll, allowing both sides of the coil to be painted in a single pass. Paint thickness is controlled by a device which allows regulated amounts of paint to be picked-up from coating pans and transferred to the applicator rolls. In addition, individual drives for each roll in the coating head permits variable speed operation and provides a wide range of precise coating thicknesses. When a spliced section of strip is passing through the coater, both applicator and pick-up rolls drop out of position as a unit, thereby maintaining their preset position for maintenance of film thickness control.

The line contains three coating heads, two to paint the top of the strip and the third to paint the underside. Only one top head is actually used in the painting operation. The second top head is designed to permit rapid color changes, allowing on-the-move one side color changes without loss of film continuity.

After leaving the coater, the metal goes through an 8-foot flow-out area, allowing for solvent flash-off before forced drying and curing in the oven.

The drying oven, a 100-foot chamber separated into three stages, is gas fired with temperature controls for each stage. Depending upon the type and specifications of the metal and the type of finish applied, line speed and stage temperatures within the drying oven vary. In general, a one-minute total bake is normal at temperatures of 250°F. in the first stage, 450°F. in the second stage, and up to 650°F. in the third stage (Fig. 3). After baking, the metal is cooled as it passes through a sprayed water quench, then is dried by guiding squeeze rolls similar to the rolls used in the preparation tanks.

Terminal equipment takes over at this stage, rewinding the strip into coil for subsequent inspection and shipping. Each coil is quality checked for pencil hardness, color match, gloss, mill thickness, fabrication, and adhesion, then transferred to the Works' Inspection & Shipping Department for final inspection, packaging, and shipment to fabricators.

Although new, the facility now is operating at full capacity, supplying fabricators with ready painted stock which eliminates the costly operation of painting finished parts.

Kaiser's decision to enter the coating industry (the company was the last of the Big Three primary producers to begin coating), was a case of a rapidly expanding market creating a soaring demand. Case in point was and is the mobile home industry whose demand for and consumption of wide pre-enameled panels has been blossoming in the past several years. Today, the preponderance of the Ravenswood product is run on the wide-line with the majority of that production going to the mobile home and residential improvement industries. The availability of wide painted stock with this balance of durability and formability has naturally created other applications; the most notable of which probably are residential and industrial siding, awnings, garage doors, and prefabricated wall panels.

Since some applications require unique service requirements due to particular customer fabrication or service and environment conditions, finishes of other types are applied with sacrifices in exterior durability characteristics. Due to the unique combination of properties of a thermal setting acrylic plus the control features of this particular application technique, a large degree of standardization has been possible, permitting the facility to fulfill the company's historic role of a major supplier for mass markets.

Science for Electroplaters

64. Nickel Plating - Watts Bath

By L. Serota

This is the second and concluding installment of Part 64 of this series by Mr. Serota. The first half appeared in the March issue.—Ed.

Current Density

The irreversibility of the nickel electrode reactions in a Watts bath ($Ni^{\circ} \rightarrow Ni^{++} + 2e$ at anode and $Ni^{++} + 2e \rightarrow Ni^{\circ}$ at cathode) at varying current densities, due to the appreciable difference in electrode potential, is shown gaphically in Fig. 9.

The high polarization in nickel plating, about 0.7 volt, corresponding to the combined anode-cathode overvoltage, is associated by W. A. Wesley with the characteristic high energy of activation necessary in transition metals for the transfer of ions. The high lattice cohesion in transition metals is attributed to the vacancies in the d band of the atom (electronic) structure.

The effect of current density on the structure of nickel deposits from a Watts bath at 55°C., pH 3.0, was found by A. Brenner and associates to change

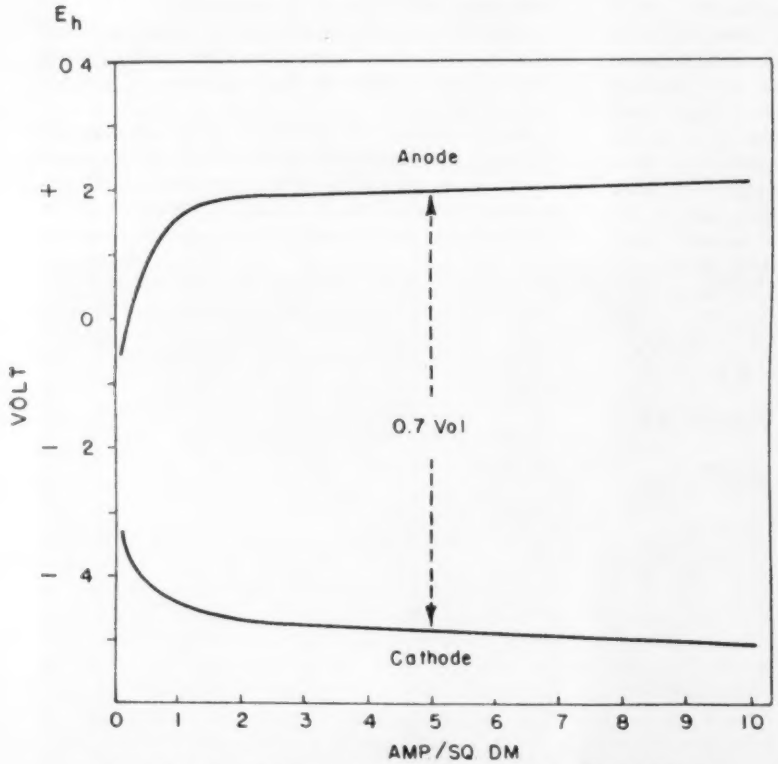

Fig. 9. Typical potential-current density curves for Watts bath. Bath at 55° C.

Fig. 10

appreciably at very low and high current densities only. At a current density of 2.3 amp./ft.^{2}, for example, a fine grained banded structure results (Fig. 10). Between the current density range of 19 and 230 amp./ft.^{2}, a columnar structure is obtained (Fig. 11). A fine-grained acicular structure, it was found, will be deposited at the very high current density of 460 amp./ft.^{2}.

A. W. Hothersall and G. E. Gardam ascribe rhythmic banding of banded structures, such as that shown in Fig. 10, to differences in chemical composition of deposited material, such as nickel hydroxide or other basic nickel compounds. The formation and deposition of these compounds varies with changes in pH at the cathode surface, with the corresponding difference in rates of diffusion of different ions. This effect produces a variation in structure (banded) composition and properties of the deposited metal.

The relationship of current density to the oxygen-hydrogen content of deposited nickel from a Watts bath (55°C.) was noted in the Brenner study. A higher oxygen-hydrogen content was developed at low current density than that obtained at the common plating range of 19 to 46 amp./ft.^{2}. A higher cathode film pH at low current density, with the formation and inclusion of basic compounds, was considered a possible cause of this higher ratio. An increase in oxygen-hydrogen content was also obtained at high cur-

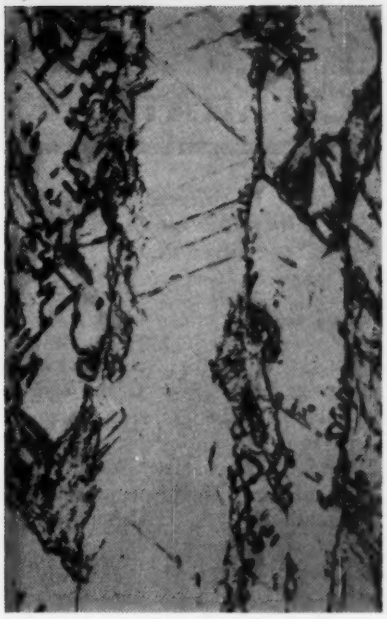

Fig. 11

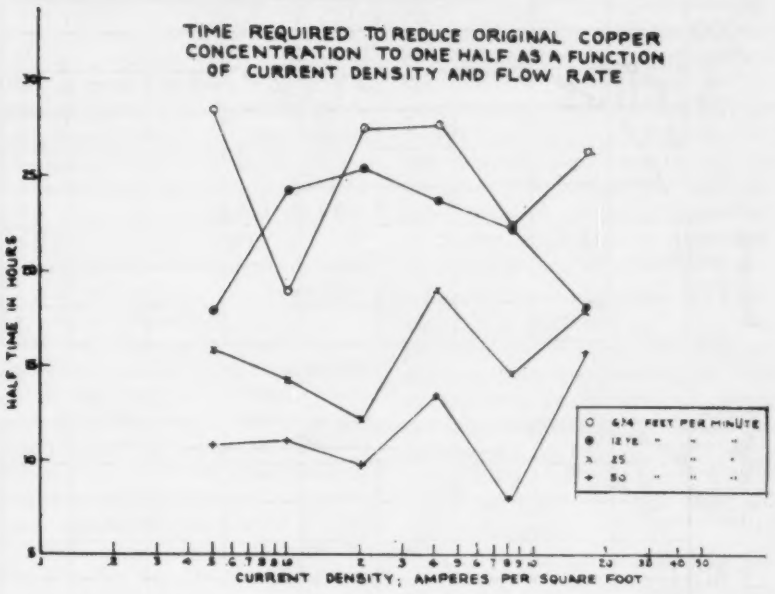

Fig. 13

rent densities. Fig. 12 shows this relationship effectively.

A high current density was found by W. A. Wesley, W. W. Sellers and E. J. Roehl to be undesirable for depositing nickel from a Watts bath for the following reasons: low limiting anode current densities, high electrolyte resistivity (higher tank voltage), and lower limiting cathode current densities. Results indicated that, when plating occurred from a Watts bath (160°F., pH 2) with a rate of flow of the electrolyte of 10 ft. min., the limiting current density for sound nickel deposits 0.001" thick was found to be 350 amp./ft.^{2}, and an unsound deposit was obtained at 400 amp./ft.^{2}. For a 0.003" deposit, same flow rate, a sound deposit resulted with a limiting current density of 300 amp./ft.^{2}, and an unsound deposit resulted at 350 amp./ft.^{2}.

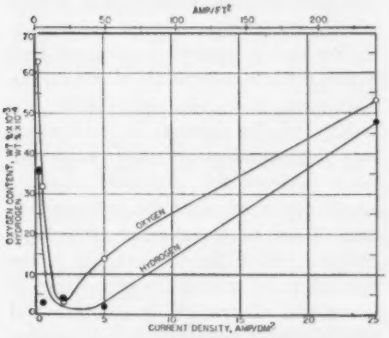

Fig. 12. Effect of current density on oxygen and hydrogen content of nickel, deposited from $S_{111}C_1$ bath at 55°C. (131°F.), and pH of 3.0.

When the flow rate of the electrolyte was increased to 100 ft./min. the limiting current density for a sound deposit 0.003" in thickness was obtained at 800 amp./ft.^{2}, and 900 amp./ft.^{2} produced in unsound deposit. Unsound deposits include burned, spongy, or streaked areas.

At a flow rate of 50 ft./min. and a current density of 500 amp./ft.^{2}, and at 100 ft./min. with a current density of 900 amp./ft.^{2} chlorine was liberated readily at the nickel anode. Changes in cell voltage and burning of deposits occurred. The substitution of carbon-bearing wrought anodes checked such evidence of passivity but, at the flow rate of 100 ft./min., carbon particles were deposited on the cathode.

Flow rate was found by A. M. Max and W. L. Whitehurst to influence the deposition (removal) of copper from a Watts nickel bath by increasing the diffusion rate of copper through the cathode film. Current density is not an important factor. The solution contained about 50 mg./l. of copper sulfate in a standard Watts bath. Experimental runs were made at current densities ranging from 0.5 to 16 amp./ft.^{2} and flow rates of 6.25 to 50 ft./min.

The time, in hours, required to reduce the copper concentration to one-half the initial concentration, recorded as half-time, is plotted as a function of current density and flow rate, Fig. 13. The graph indicates the effect of flow rate on half-time. Diffusion rate is increased with increasing flow-rate. Current density, however, has little if any effect on half-time values.

Cathode Efficiency

The effect of temperature, pH, and current density on the cathode effi-

TABLE V. ***Sulfate Bath***

Current Density (asf) Sulfate	*Current Efficiency*
5	99.6
20	98.6
30	98.6
40	101.0
60	89.9
80	88.7
100	82.2

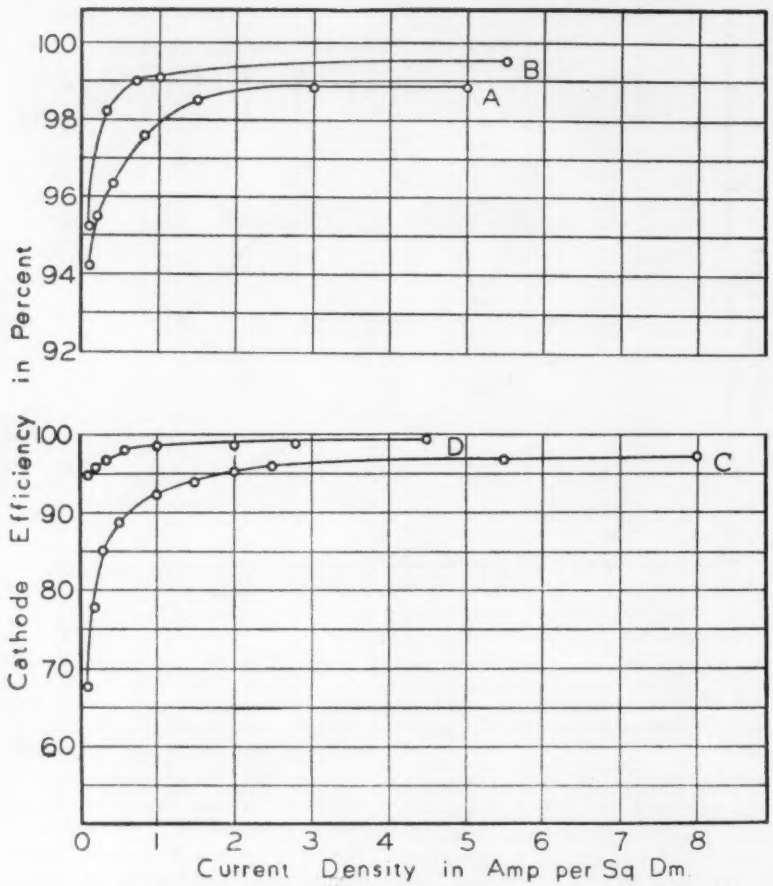

Fig. 14. Cathode current efficiency. A—hard bath; B—Watts pH 5.5; C—Watts pH 2.0; D—chloride bath.

ciency of a Watts bath was included by A. Brenner and associates in their study of the properties of electrodeposited nickel. Table V represents the effect of varying temperatures and current densities on cathode efficiency.

Efficiency, it will be noted, was only affected by temperature changes at a low pH of 1.5. Thus, experiment #4, at 30°C., showed a cathode efficiency of 77% while, for experiment #5, at 80°C. (pH-1.5) the efficiency was 99%. By contrast, experiment #1 to #3 (pH-3) gave cathode efficiencies of 100% or very close to it over a temperature range of 20° to 80°C.

Current density, the data in the table reveal, has little effect on cathode efficiency. The exceptions, experiments 7 and 8 with current densities less than 1 amp./dm.^{2}, exhibit a relatively light effect in the reduction of cathode efficiencies. Variations in pH have little effect on cathode current efficiencies, with the exception of the low pH range of 1 to 1.5. A pH of 3 or more gave virtually 100% cathode current efficiencies.

The efficiency values were determined by measuring the weight of deposited nickel on a gold rod. A stopwatch and calibrated ammeter were used for measuring time and current. Results were considered accurate to about one per cent. A copper coulometer was used in the circuit for some of the experiments. The Watts bath consisted of 28 oz./gal. $NiSO_4 \cdot 6H_2O$; 8 oz./gal. $NiCl_2 \cdot 6H_2O$; 4 oz./gal. H_3BO_3.

W. A. Wesley and E. J. Roehl, in their study of cathode efficiency and its relation to throwing power obtained the following cathode efficiency curves: Fig. 14. Curve B refers to the high pH (5.5) bath and Curve C the low pH (2.0) bath. The nickel chloride bath, Curve D, and the hard nickel bath, Curve A, were found to exhibit higher throwing power than either Watts bath.

FOREIGN LITERATURE

Influence of Current Density and Temperature on Quality of Silver Plate

A. Saglier: *Galvano* (Paris), **27,** No. 255.

In baths used to apply a thin deposit, in which the silver content is normally below 20 g./l., the current density should be limited to 0.2 amp./dm.^{2} In the case of electrolytes formulated for thicker silver deposits, and in which the silver content will vary from 20 to 25 g./l., the current density can be raised to 0.3 amp./dm.^{2} The conductivity of the electrolytes must be such as to allow of attaining these current figures at 1.5 volts and a spacing distance of about 15 cm. between the electrodes, with a sufficient proportion of salts in solution.

A greater spacing distance between the anode and cathode increases the resistance and these current densities can then only be maintained by increasing the voltage. For an electrolyte containing 25 g./l. silver, an increase of 5 cm. in the distance between anode and cathode corresponds to a circuit rise of 0.5 volt.

Too-high a current density can lead to too-great a generation of gas on the electrodes and adversely effect the quality of the deposit. If it is necessary to maintain a relatively large distance between the electrodes, for example for reasons of the cathode volume, it will be found more advantageous to increase the conductivity of the electrolyte by raising the proportion of silver and of cyanide in solution and by adding potassium carbonate, rather than by increasing the voltage.

The current density employed has a very great influence on the silver deposit. If low current density is used, the plating time is prolonged and large, coarse-sized crystals are formed which are difficult to polish. If too high a current density is used, the silver deposit will be formed of very fine crystals, which tend to lack cohesion. The figures given above, which correspond to a fairly slow silver plating rate, are those tested by experience. They permit of obtaining with a bath temperature of from 15° to 25°C. and

with an electrolyte of normal formulation, a micro-crystalline silver deposit, of silky appearance, which is easily polished with a minimum loss of material.

The bath temperature has an influence on the quality of the deposit. By increasing the conductivity of the electrolyte, a rise in temperature, within certain limits, permits reducing the voltage while maintaining the same current density; this is a condition favorable to the quality of the deposit. On the other hand, increasing the temperature does serve to reduce the throwing power slightly and those parts farther removed from the anode receive a lesser deposit.

For a thick silver deposit, the optimum bath temperature is 20° and 25° C. Below 10°C. it is almost impossible to obtain any really good deposit. In fact, below this temperature it is necessary to raise the voltage appreciably so as to maintain a current density allowing the required deposit to be achieved within a reasonable time period. Gas production can then be sufficient to prejudice the quality of the deposit.

Consequently, the bath temperature should be at least 15°C. and heating arrangements should be provided to ensure this. For high-speed silver plating, a bath temperature of 30-35°C. and a current density which can exceed 1 amp./dm.^{2} are employed. In these high speed baths, the silver content is at least 30 g./l. and the free cyanide exceeds 40 g./l. Vigorous agitation is provided by rotary pumps; cathode movement is often also provided.

Above 30°C. a serious disadvantage is that the temperature increase serves to increase the decomposition of the free cyanide.

Bright Nickel Bath Purification

G. Bacquias: *Galvano* (Paris) **29,** No. 281, 339.

Physical impurities comprise all the fine particles or slimes originating from the anode, residues from the nickel salts, and fine nickel powder. During electroplating at high current density, these particles ionize and codeposit at the cathode with the nickel, giving a heterogeneous deposit of poor appearance. Bagging of the anodes and continuous bath filtration are required. To be effective, the total volume of electrolyte should pass through the filter at least once each hour.

The chemical impurities are zinc, copper, iron, chromium, lead, and tin. Although zinc can have a favorable effect in small quantities, it is quite a different matter with chromium which can prevent adhesion of the deposit. Two means can be employed to eliminate these impurities and can be used either separately or together. Selective electrolysis at a low voltage on a corrugated sheet is effective in the case of zinc and copper, but inoperative for iron and chromium.

On the other hand, complexing or chelation by means of the sodium salts of E.D.T.A. does result in total elimination of all the metals (except in the case of zinc) in a bath with pH at or below 3. In addition, this treatment eliminates all the calcium and magnesium compounds introduced by the hardness of the water, and has no action on the majority of the brightening agents. The metals are transformed into very stable, soluble chelates, which then are without action on the electrolyte.

Only relatively small quantities are required: 1 gram of the tetrasodium salt of E.D.T.A. can complex 154 mg. of zinc, 150 mg. of copper, 132 mg. of iron, 94 mg. of calcium, or 58 mg. of magnesium. A precise quantitative analysis of the foreign metals present should be made prior to the treatment so as to use only the quantity necessary. The organic chemical impurities originate in part from the decomposition of the brightening agents. For small quantities, their elimination can be made by filtration with activated carbon. For larger quantities, for example where an excessive amount of brightening agent has been used, it is preferable to treat the bath by oxidation with potassium permanganate. For this treatment, the bath should be kept hot for 48 hours, and should be agitated as often as possible during the continuous filtration. The pH is adjusted to the normal value and the brightener added according to Hull cell tests.

Preparation for Adherent Electroplating

P. Badet: *Galvano* (Paris), **28,** No. 268, 230.

The method of manufacturing of the part, apart from any direct and specific influence on the adhesion, can produce different surface fouling, according to whether the parts have been cast, pressed, rolled, drawn, or machined. A more or less profound alteration or distortion of the surface can be encountered. Where the metal has been subjected to a localized and intense heating, a surface film may be present which is subjected in depth to high internal stresses due to cold deformation. The surface film can also have inclusions of metallic particles, an absorption of drawing compounds or a thick coating of oxides.

Heat treatment can lead to the formation of a thick coating of oxides, formation of complex salts due to chemical reactions produced at high temperatures, the presence of carbon and other undesirable elements on the surface, and the formation of a more or less thick coating of baked tempering oil (this last coating is very difficult to eliminate).

Parts of this nature should be polished for a number of reasons. Before polishing, it is sometimes necessary to remove the coating of oxides. Precleaning can be conducted either by immersion in a hot alkaline bath or else by spray-treatment with an emulsified solvent. This pre-treatment decreases the pickling time but can foul the surface. It can lead to the formation of insoluble lime salts originating from the water, the formation of a film of phosphates, silicates, soap, or glycerine residues from the cleaning and, in places, a non-adherent deposit of metallic impurities. This does not interfere much if a strong acid pickle is used; thorough rinsing, nevertheless, should be given after pre-cleaning.

It is quite generally held that a basis metal with a very smooth surface will give better adhesion of the subsequent electroplate. This is not always confirmed in practice, however. Polishing should be conducted carefully, otherwise adhesion troubles will follow. In many cases, and certainly with thick deposits, an electropolish before plating will be found to be of advantage. The electropolishing treatment produces a removal of the top surface film and leaves the basis metal in the best condition to receive the subsequent plating.

When a part is being prepared to receive a thick deposit (hard chromium or nickel) the surface treatment can be conducted by using a liquid jet of abrasive for the surface preparation. This treatment has the advantage of being rapid and is of consid-

(*Continued on page* 73)

SHOP PROBLEMS

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gladly received and the sender's name will be kept confidential, if desired.

Effects of Temperature on Film Properties

Question: When an enamel may be either air dried or baked, is there any advantage to baking it other than that the process is speeded up?

H. B.

Answer: Generally, temperatures below about 200°F. are considered as force drying rather than baking temperatures. There are a few advantages in force drying enamels when there is a choice available. Scratch adhesion and impact properties are frequently improved by force drying. Since less permeable films are often developed by force drying, it is often possible to obtain equally good corrosion resistance with much thinner coatings.

Blackening Stainless Steel

Question: We manufacture a gauge bar made of ¾" and ¼" type 304 stainless steel. These are made in various lengths, and the calibrations on these bars are etched by a chemical process. As the bars are polished to a satin finish and the etched lines are close to being the same finish, there is very little contrast, which makes the bar a little hard to read.

What we are seeking is some way to make the calibrated lines dark for a good contrast. The catch is that whatever process is used must make permanent dark lines which are not affected by cleaners, caustics, etc.

E. C. T.

Answer: A highly resistant black finish on stainless steel can be produced by immersion in a molten mixture of equal parts of sodium dichromate and potassium dichromate at about 750°F. A number of patents on this process have been issued to Armco Steel Corp.

After blackening, the film can be removed from the surface by use of a belt polisher on a hard platen or a rock-hard felt wheel with greaseless compound, which will not reach into the etched lines.

Silver Recovery from Strips

Question: We strip silver from stainless steel in concentrated nitric acid and silver plate from brass in the 19-1 sulfuric-nitric strip. These strips become quite loaded with silver salts. How can we recover the silver from these strip solutions? Is there a market for reclaimed silver metal or silver salts? We would prefer to plate the silver out so we can reuse it.

K. H.

Answer: The silver can be recovered from the strip by dilution and addition of sodium chloride solution to precipitate silver chloride. If the silver chloride is washed thoroughly to remove all traces of the acids and contaminating salts, it can then be dissolved in sodium cyanide and the metal plated out, using insoluble anodes. However, we believe it will be cheaper to give the silver chloride a couple of water washes and send it out for refining.

Pickling Steel

Question: In order to avoid handling strong mineral acids in our plant, we prefer to use citric acid for pickling our steel parts prior to painting. We have heard that this chemical will do a good job of rust removal but we have no information on the amount to use. Can you furnish us with information on this subject?

L. T. L.

Answer: A 3-5% solution is usually employed for rust removal. As the reaction proceeds, ferrous hydrogen citrate is formed, which precipitates eventually. By neutralizing part of the acid with ammonia (3-4 gal. to each 100 lbs. of citric acid), the reaction product becomes ferrous ammonium citrate, which is very soluble and does not precipitate.

"White" Anodize

Question: We are interested in obtaining an anodized "white" color for our aluminum products. Do you know of any supplier who can furnish a "white" color for anodizing?

P. M.

Answer: We have no information on any process for "white" anodizing; however, an opaque film was claimed by M. Schenk (U. S. Pat. #2,231,373), involving use of a titanyl compound. This patent is now in the public domain. According to the patent, the following solution is employed:

Titanyl potassium oxalate	50 Kg.
Citric acid	15 "
Glucose	20 "
Phosphoric acid	6 "
Water	1000 "

Alternating current is used, at 5-6 amp./sq. dm., and a temperature of 75° C.

A more recent patent was granted to Freud & Frasch (Swiss Pat. #287,574), employing a zirconium salt in a sulfuric acid or oxalic acid bath, which would appear to be similar to the above.

Tank Construction

Question: We are planning on welding up an insulated black oxide tank, size 50" x 24" x 36" deep. The tank will be on legs and will have drilled pipe burners for heating. Do you have any suggestions on the construction of such tanks, or any literature available on same?

T. M.

Answer: A tank this size should be constructed of ¼" boiler plate, double welded, with a 2"-3" lip around the top. The sides should be insulated with 1"-2" of lagging for heat conservation, and the insulation covered with a sheet of galvanized iron to avoid wetting the material.

It would be advisable to place another sheet of boiler plate under the tank to take the direct heat of the

burners. This will eliminate scaling and will prolong the life of the tank. It should also be remembered that the tank will hold about 165 gallons of solution, when filled to within 4" of the top, so that the total weight on the four legs will be about two tons. Flat bearing plates should be set under the legs to spread the load.

Chromating Test

Question: Is there simple, rapid test which will tell us whether our zinc and cadmium plated steel stampings have been given a passivating chromate dip? We receive these parts from our contract plater with a bright finish but have noticed some tendency at times to fingerprint easily during assembly, and wonder whether a non-passivating bright dip was used. We are familiar with the diphenylcarbazide test but the solution is rather involved and we do not use it sufficiently to warrant preparing it at frequent intervals, which is required because of its instability.

J. K. S.

Answer: A simple test for passivity of cadmium and zinc is to apply a 5 g./l. solution of copper sulfate to the surface. Absence of passivity is indicated by appearance of an immersion copper deposit.

Trivalent Chromium Oxidation

Question: Because of the large difference in surface area between our work and our inside lead anodes, our chromium tank tends to build up in trivalent chromium content. We have used a porous pot for reoxidizing the trivalent chromium, with fairly good results. However, their life is quite short and maintenance is a problem. Is there any other way to remove the trivalent or to oxidize it back to chromic acid? P. B.

Answer: Oxidation with potassium permanganate has been suggested in the literature from time to time. Each ounce of Cr_2O_3 requires 2.7 oz. $KMnO_4$, which should be added with agitation to the solution at about 125-130° F. After 12 hours, the precipitated manganese dioxide is filtered off through polyvinyl chloride cloth.

Another method is to electrolyze with a small steel rod as cathode, having a surface area about 2-3% of the anode area (current densities of 20 amp./ft.^{2} anodic, and 700-1,000 amp./ft.^{2} cathodic). At a temperature of about 175-180° F. reoxidation of the trivalent chromium is fairly rapid.

Patents

RECENTLY GRANTED PATENTS IN THE METAL FINISHING FIELD

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Rust-Inhibiting Acid Pickle

U. S. Patent 2,964,434. *Dec.* 13, 1960. *W. B. Coleman, assignor to Victor Chemical Works.*

A method of pickling and inhibiting the rusting of the surface of a ferrous metal article in a single bath comprising said article in a heated pickling and rust-inhibiting bath having a pH not greater than 1 and which contains a minor proportion of a pickling acid equivalent to not more than about 20% concentrated acid, said acid being from the group consisting of sulfuric acid, phosphoric acid, and admixtures thereof, and which contains at least about 0.4% by weight of a boron-phosphate rust inhibitor having a mole ratio of phosphorus to boron of at least about 1 to 1 and not more than about 17.3 to 1; and removing the pickled and rust-inhibited article from the bath.

Conversion Coating — Zinc

U. S. Patent 2,964,433. *Dec.* 13, 1960. *H. T. Francis and F. H. Roebuck, assignors to National Steel Corp.*

A process for treating material having a zinc surface to improve corrosion resistance comprising bringing a solution consisting essentially of at least one compound which is a source of zinc ion and at least one compound which is a source of chromate ion dissolved in a volatile solvent into intimate contact with the zinc surface of the material, the solution being free of a substance which is a reducing agent for chromate ion and containing a ratio of zinc ion to chromate ion of 9:1 to 1:9.5, the zinc surface to be contacted with the solution being initially at a temperature substantially above the boiling point of the solvent and below the melting point of zinc, the volume of solution contacted with the zinc surface being controlled and the temperature of the zinc surface being sufficiently elevated so as to volatilize the volatile components of the solution substantially immediately after contact and produce a substantially colorless corrosion resistant film on the zinc surface.

Flexible Abrasive Wheel

U. S. Patent 2,964,887. *Dec.* 20, 1960. *G. H. Orozco, assignor to Fin Del Co.*

A laminated one-direction polishing wheel comprising a hub and a multiplicity of circumferentially extending flexible abrasive flaps mounted in cantilever fashion on said hub around the circumference of the wheel.

Vacuum Coating Apparatus

U. S. Patent 2,965,067. *Dec.* 20, 1960. *J. A. Amelotte and M. L. Harlow, assignors to National Research Corp.*

A vacuum coating apparatus comprising chamber walls creating a chamber which defines a low pressure coating zone from a zone of higher pressure, vacuum pump means for maintaining a low pressure in said chamber, a source of coating vapors in said chamber, and means for minimizing air leak into the coating zone and precluding chafing of a substrate while passing the substrate between the low pressure coating zone and a zone of higher pressure.

Pickling Steel

U. S. Patent 2,965,523. *Dec.* 20, 1960. *J. P. Engle, assignor to The Dow Chemical Co.*

The method of removing adhering scale from a scale-coated ferrous metal surface which is subject to stress-cracking due to residual chloride which comprises the steps of (1) subjecting the adhering scale to the action of an aqueous solution containing between 5 to 30 per cent phosphoric acid at from 100°F. to 200°F. for a sufficient time to loosen at least the more exposed portions of the scale and expose new areas of said adhering scale, subjecting the thus loosened scale to the action of an aqueous solution of a caustic selected from the class consisting of the hydroxides and carbonates of the alkali metals at from 175° to 212°F. to dissolve the thus loosened scale, followed by 5-30% phosphoric acid pickling.

Pickling Titanium and Zirconium

U. S. Patent 2,965,521. *Dec.* 20, 1960. *H. B. Bomberger and M. B. Vordahl, assignors to Crucible Steel Co. of America.*

The method of pickling a metal selected from the group consisting of titanium, zirconium and alloys of each with removal of metal from the surface, which comprises: immersing the metal in an aqueous pickling solution containing in percentages by weight, about 0.5 to 5% of fluoride ions, and about 5 to 35% of hydrogen peroxide, while maintaining said solution at a temperature of about 100° to 190°F.

Nickel Plating

U. S. Patent 2,965,551. *Dec.* 20, 1960. *H. Richaud, assignor to Pechiney Compagnie de Produits Chimiques et Electrometallurgiques.*

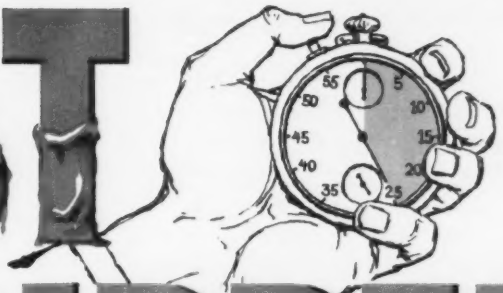
A process for coating a metal surface with nickel, comprising the steps of (*a*) degreasing and cleaning the surface in a conventional manner, and (*b*) subjecting the cleaned surface to electrolytic oxidation in a bath capable of providing an oxidizing environment at the anode, said bath containing at least one compound of nickel and at least one reducing agent being a mineral salt selected from the group consisting of sulfites, thiosulfates, hydrosulfites, arsenites, phosphites, and hypophosphites, and (*c*) coating the oxidic layer thus formed on said surface in a coating bath with a cover layer of nickel.

Printed Circuits

U. S. Patent 2,965,952. *Dec.* 27, 1960. *F. M. Gillett and A. A. Katz, assignors to the United States of America.*

A method of manufacturing etched circuitry comprising, in combination, the steps of: punching a plurality of holes through a sheet of dielectric material having relatively thin sheets of conductive material secured to each side thereof; plating said sheet and annular surfaces of said holes with a conductive material; coating said plated sheet with an adhesive; covering said holes with a portion of the pattern carried by a decalcomania, whereby said

FAST STRIPPERS



- ✓ **FAST, CLEAN WORKING**...unlike caustics or strong acids, these strippers do not dissolve or decompose enamel or lacquer. These strippers break the bond between the metal and the organic coating. Loosened coating then slips off in sheets or shreds.
- ✓ **NON-CORRODING**...our strippers do not attack aluminum, zinc, ferrous metals or any other metal or alloy.
- ✓ **CONVENIENT**...stripped metal may be rinsed with water, dried and refinished immediately.

LEA COLDSTRIP

1. Requires no dilution. Use full strength.
2. No heating required. Use at room temperature.
3. Although toxicity is low, care should be taken to avoid contact with the skin.
4. Minimum ventilation required.
5. Can be strained for continued use.
6. Surface of Coldstrip is self-sealing (reduces evaporation).

LEA SYNSTRIP

1. May or may not be diluted with water, depending upon the film adherence.
   Maximum dilution should be 1 part Synstrip to 6 parts water.
2. Can be used cold or heated. Heating to temperature from 160° to 200°F. cuts stripping time.
3. Toxic. Avoid inhaling or contact with skin.
4. Heated solution requires ventilation to remove fumes.
5. Can be strained for continued use.
6. Evaporated water should be replaced to maintain concentration. Baumé readings on a hydrometer will determine the amount of water to add.

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featured by these highlights:—

- **Simplicity of Operation—only one brightener used to produce lustrous deposits**
- **Exceptional Hiding and Micro-Leveling Qualities**
- **High Tolerance to Organic and Metallic Contaminators, including zinc**
- **Lustrous copper deposits secured at high rates of deposition. Readily nickel plated**
- **More Die Castings are Plated in Q-Level than any other Copper Bath**

The Q-Level Process is applicable where maximum hiding of surface imperfections is demanded and full brightness not required. Improved grain structure enhances subsequent bright nickel deposits even over "burned" copper area . . . Q-Level will hide most 'cold shots' in zinc base die castings; surface roughness of 10 RMS or below tend to be leveled . . copper plate from Q-Level is easily buffable, much more so than deposits from conventional cyanide baths. . . . Air or mechanical type agitated baths with direct, current interruption or periodic reverse available.

Our technical staff will show you how to get maximum results by changing over your present cyanide process to Q-Level.

*Patented and Patents Pending

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decalcomania overlies said sheet in an aligned manner, securing said decalcomania in tight contact with said adhesive; moistening and removing a backing sheet from said decalcomania; removing excess adhesive from areas of said plated sheet not covered by said decalcomanic pattern; exposing said sheet together with said decalcomania to an acid etching solution, said pattern serving as a resist to the effect of such etching solution, said etching solution serving to displace portions of said metallic sheets in areas not covered by said decalcomanic pattern; and removing said decalcomanic pattern together with adhesive residing between said pattern and said plated surface of said sheet, whereby to leave an etched pattern of relatively narrow strips of conductive material on the surface of said dielectric material.

Gas Plating

U. S. Patent 2,966,427. *Dec.* 27, 1960. *E. R. Breining, assignor to Union Carbide Corp.*

The process of alloy formation which comprises combining in the vapor state a volume of a heat decomposable phosphorus component and a volume of a heat decomposable metal bearing gas, and contacting an object heated to the decomposition temperature of the combined vapors to effect deposition of a phosphorus containing alloy on the object.

FOREIGN LITERATURE

(*Continued from page* 67)

erable help in those cases where the part is of complex shape. Where an abrasive grain is used of appropriate particle size, it is possible to remove even very thick coatings of oxides. The advantage over pickling or mechanical polishing is that no hydrogen occlusion is caused and no heating-up effect.

Although this treatment does eliminate all the surface fouling, alone it does not permit obtaining satisfactory adhesion. One should proceed by giving a light electrolytic cleaning, followed by anodic acid pickling. Employed as a polishing treatment, the liquid abrasive jet treatment, instead of adversely altering the surface coating of metal, can have a beneficial effect which is shown by an increase in the fatigue strength of the treated part.

RECENT DEVELOPMENTS

NEW

METHODS, MATERIALS AND EQUIPMENT FOR METAL FINISHING INDUSTRIES

Plating Unit

Meaker Co., Sub. of Sel-Rex Corp., Dept. MF, Nutley 10, N. J.

A compact plating unit measuring only 30″ x 26″ x 18″ to the work top contains all the equipment and features for precision-plating of jewelry, electronic parts, specification precious metal plating, or "pilot plant" set-ups. A completely re-designed smaller version of this firm's Jet Plater, the new models are said to permit either barrel or rack plating with any cold alkaline solution, and most acid plating solutions, on a mass-production basis.

It is claimed that the new Junior Jet Platers provide the ideal operation for precision-plating: i.e., a plastic centrifugal pump in conjunction with a vinyl, jet orifice manifold at the bottom of the plating tank, causes the plating solution to swirl constantly around the work, assuring smooth, even deposits. In operation, the solution is continuously drawn off from the bottom of the tank, circulated through the pump and built-in filter, and returned to the tank under pressure.

All operations are controlled from a convenient panel board which incorporates dual scale ammeter, powerstat control for rectifier, circuit breakers, and automatic timer which sounds alarm upon completion of plating cycle.

Immersion Gold

Technic, Inc., Dept. MF, P.O. Box 965, Providence, R. I.

Oromerse is a new 24 Kt neutral immersion gold which offers a fast, economical means of depositing thin plates of 24 Kt gold directly on copper, brass, nickel, iron, lead and solder plates without the use of anodes or currents. Direct deposits as thick as 70 millionths of an inch are possible over solder, it is claimed.

The deposit is extremely dense, with no variance in thickness on any area or recess reached by the solution. The solution over solder plate will deposit up to 70 millionths in 30 minutes; on iron, it will plate up to 18 millionths of an inch within 30 minutes.

Polishing Lubricant

American Buff Co., Dept. MF, 2414 S. LaSalle St., Chicago 16, Ill.

No. 371 Polishing Lubricant is 100% saponifiable, keeps the belt open and free-cutting at all times, will go through both alkaline cleaners and vapor degreasers, and does not contain fillers. It is tube-packaged in cylinders 2½″ x 8″ and 2″ x 12″.

A specially-formulated lubricant, Grade No. 301, is also available. It is compounded for use on set-up wheels. It is packaged for either manual or automatic application.

Burnishing Compound

Metal Finishing Dept., Hubbard-Hall Chem. Co., Dept. MF, Waterbury 20, Conn.

A non-saponaceous burnishing compound that actually safeguards steel media while producing a lustrous finish on brass, copper and nickel silver parts, TV-4 may also be used on silver, stainless steel and steel surfaces. Special inhibitors provide positive protection against pitting and corrosion of steel media. Also, acid pickling prior to burnishing may be eliminated except in cases of extremely severe tarnish. Oxide film and tarnish are removed from parts while they are being burnished, making acid treatment unnecessary.

Dry Acid Compound

DuBois Chemicals, Inc., Dept. MF, Broadway at Seventh, Cincinnati 2, Ohio.

Super Di-Ca, a new compound based on sulfamic acid, is claimed to achieve better results over old methods of acid cleaning. It's handled dry from the drum until it's dissolved in a dispenser or cleaning tank, thereby ending container splashing or breakage risks. The product is a descaling agent, primarily, plus cleaning and inhibiting properties, without hazardous or corrosive fumes, no pitting or stress-cracking of stainless steel and lower handling and storage costs.

Parts Cleaning Unit

Magnus Chemical Co., Inc., Dept. MF, Garwood, N. J.

The 20 gallon Mini Dip unit, a new, low-cost, 45 pound capacity parts cleaning machine for small shops, and for decentralized cleaning in the larger ones, fills the gap between the manufacturer's 5 to 6 gallon units and its larger, stationary cleaning machines.

The new unit consists of a 20 gallon openhead drum — packed with 15 gallons of decarbonizing, desludging, devarnishing compound, a basket that

"THROWS, LEVELS, BRIGHTENS BETTER than any bright nickel bath we've tried before." Speaking of Levelume 220 are partners MIKE SPANOS and FRANK WROBEL, A&A Plating Co., Detroit, shown with some of their 40 types of work.

20% more production on toughest job shop plating

...at no extra cost

Nothing tests a bath like a job shop—and A&A Plating Co. is one that often takes on "problem" jobs for other platers. Work ranges from marble size to big cash register shells, much of it tough combinations of zinc die casts and steel. And in 9 years of testing, A&A hasn't found a bright nickel bath that's "more profitable or easier to work with than Levelume 220." Some of the benefits that A&A reports:

Easy Maintenance. Levelume requires minimum analytical control. A&A's bath did not require batch purification during its first 13 month's operation.

Buffing Eliminated on some jobs—at savings to $25 per 1000 parts. Same high-quality finish is achieved.

Auxiliary Anodes Eliminated. Levelume takes chrome "better than anything" in recessed areas.

Faster Plating. A&A has stepped up current and gets 20% more production at no increased cost.

What can *your* shop achieve with high-leveling, better-brightening Levelume 220? Contact H-VW-M for technical details.

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Alert Supply Company is H-VW-M in the West • Los Angeles • San Francisco

fits inside the drum, and the compressed-air-operated, automatically agitated unit that fits over the top of the drum. A mechanic loads the basket, sets the unit into operation and returns to principal duties. The machine does the cleaning, freeing him from the many manhours of hand brushing and scraping that, in conventional shop operations, prove very costly.

Airless Spray Pump

The DeVilbiss Co., Dept. MF, Toledo 1, Ohio.

A new compact, light-weight airless pump makes the advantages of airless spray available for medium production operations at minimum cost. The 17-pound, five gallon capacity pump consists of lid, five gallon material container and handle. The 26-1 ratio pump will handle all conventional paints, using the standard airless gun fitted with medium production caps, and will operate with air pressure produced by as small as a 1 h.p. compressor. A chromium piston in a stainless steel tube operated by a quiet, time-proven air motor insures long, trouble-free service, according to the manufacturer.

Now available also is a new nylon, plastic-covered, high pressure fluid hose with spiral static wire for use with the unit at a cost approximately one-third the price of hose used with larger airless units.

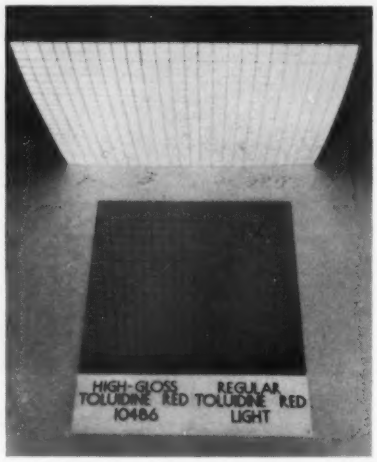
Accessories offered with the pump include a regulator assembly with gauge and blow gun, recommended for use with non-regulated air; a new material strainer to be attached at the pump outlet, and a swivel connection between the fluid hose and gun for greater flexibility in spraying.

Toluidine Red Pigment

Sherwin-Williams Co., Pigment, Color and Chemical Div., Dept. MF, 260 Madison Ave., New York 16, N. Y.

A distinctive yellow shade Toluidine Red pigment for paints which produces a high-gloss, haze-resistant finish is now available from the above firm.

The accompanying photograph shows the reflection pattern of the new high-gloss Red Light 10486 compared to a conventional Toluidine Red pigment. Outside exposure tests show that it maintains its higher gloss for more than nine months and indications are that additional exposure up to the limit of the durability of the film will continue to show a noticeable improvement.

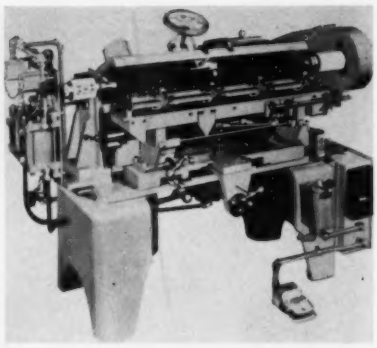


The freedom from haze obtained with this new Toluidine Red is outstanding. In both the case of the higher gloss and the haze resistance, the effect of the vehicle is of such importance that tests should be made in the vehicle to be used. The excellent light resistance, alkali resistance and hiding for which Toluidine Red pigments are known are also found in this new standard.

Polishing Machine

Clair Mfg. Co., Dept. MF, Olean, N. Y.

Model No. 405 is the response to an insistent demand for a smaller and even more flexible table-type design polisher with reversible roll as small as 1¾" diameter, table actuations adjustable to extremely high frequencies, and super-sensitive contact pressure automatically variable over any predetermined increment of coverage. Thus many small and intricate shapes, previously processed manually, can now be batch finished mechanically, i.e., industrial jewelry, decorative hardware, handtools, tableware, etc.



Soak Cleaner

Oakite Products, Inc., Dept. MF, 118 Rector St., New York 6, N. Y.

A new compound designed expressly for the removal of heavy and tenacious soils by immersion, HD 126 has a pH of 13.5 in the recommended solution concentration. Containing no rosin or soap, the compound is said to be completely rinsable. It is safe on steel, brass, and magnesium; but is not recommended for use on aluminum and zinc. It is also said to have applications in barrel cleaning before plating operations, and for cleaning before vitreous enamel finishing.

For most soak tank cleaning uses, recommended concentrations range from 4 to 12 oz./gal. and temperature from 180° to 195° F. The concentration recommended for barrel cleaning and cleaning before vitreous enameling is 8 oz./gal. at 180° F. The new cleaner is particularly recommended for use in hard water areas.

Organic Aluminum Coating

S. C. Johnson & Son, Inc., Dept. MF, Racine, Wis.

An aluminum coating to provide protection from damage by wet mortar for 30 days, Perma-Cote 61 also gives aluminum, other non-ferrous metals, and stainless steel full protection against acids, alkali and outdoor exposure, it is claimed. The material is a colorless, non-yellowing coating which forms a tough, glossy film that will not discolor when exposed to ultraviolet rays. It possesses excellent adhesive qualities and can be applied economic-

ally by dip, brush or spray. The coating dries tack-free in two to three minutes at room temperatures and 50 per cent relative humidity.

The product is marketed in 55-gallon drums. However, smaller sizes are being made available to fabricators and users of aluminum building components for demonstrations and small scale tests.

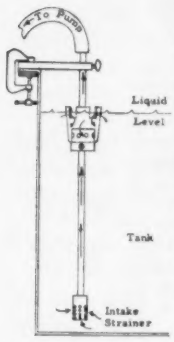
New Low-Bake Gloss Enamel

Advance Process Supply Co., Dept. MF, 2315 W. Huron St., Chicago 12, Ill.

A low bake, high gloss enamel, identified as the BET Series, cures in three to five minutes at 250°F., and thereafter is solvent and chemical resistant. It is recommended as excellent for metal signs and displays, metal toys, aluminum parts, electronic marking and dials.

Combination Skimmer—Strainer

Sethco Mfg. Corp., Dept. MF, 2284 Babylon Turnpike, Merrick, N. Y.



Available in all plastic construction for resistance to corrosive chemicals, this skimmer will remove floating particles from any solution. It will also draw liquid simultaneously from any depth in the tank. For convenience in mounting, a Bakelite holder and "C" clamp are furnished for attaching to any tank and for adjustment to any liquid level.

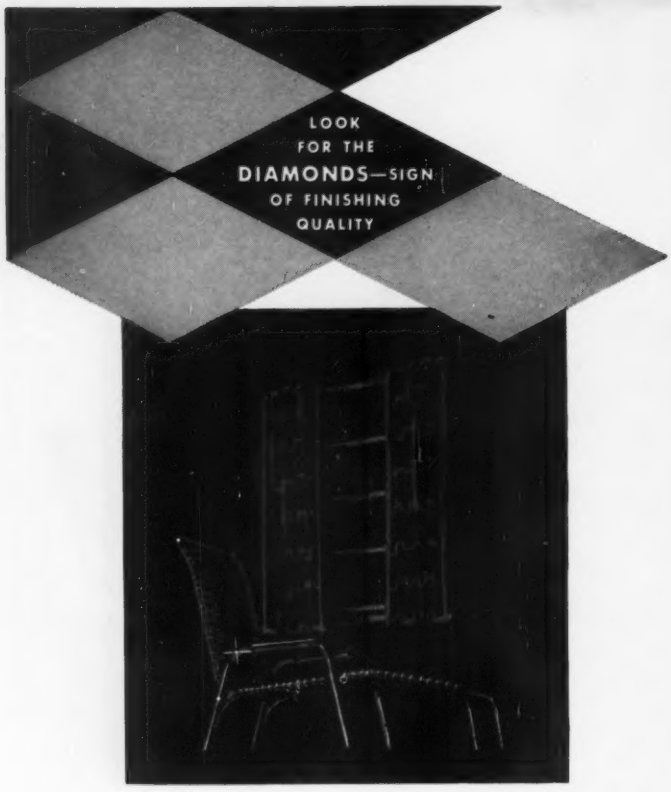
The skimmer also acts as an automatic safety cut-off to eliminate any danger of siphoning due to any breakage in the outside filter system. As soon as liquid falls below the intake point of the skimmer, air will be sucked in to break the siphoning action.

The skimmer is available in three sizes for ½", ¾", and 1" ID hose.

Liquid Polishing Composition

Meyers & Ellis, Inc., Dept. MF, 10 S. LaSalle St., Chicago 3, Ill.

A liquid metal polishing composition that prevents loading of abrasives, "Miracle" also acts as a cutting agent and an ideal lubricant. It gives grinding wheels, abrasive belts and discs



NOW—A Great New Combination for DOUBLE PROTECTION Against Corrosive Conditions on Aluminum, Magnesium or Zinc

IRIDITE®
CHROMATE CONVERSION COATINGS
and
IRILAC™
CLEAR PROTECTIVE COATINGS

Now, here's a fast, easy, economical way to almost double the protection against corrosion on your product. Simply follow up the IRIDITE process with a fast, easy application of IRILAC . . . and you've given your product extra protection for longer resistance to corrosive conditions, longer shelf or storage life protection from handling, and increased beauty for more attractive appearance and faster sales.

ON ALUMINUM

An IRIDITE-IRILAC finish will provide longer life for storm doors, windows, outdoor furniture, auto parts and accessories, tubing or wire goods. And, you have a choice of color finishes such as natural aluminum and golden yellow. Other colors may be obtained by an additional dye operation.

ON MAGNESIUM

IRILAC over an IRIDITE No. 15 finish increases corrosion protection, and provides resistance to finger printing and abrasion on all types of products, with color appearance ranging from light to dark brown.

ON ZINC

IRIDITE plus IRILAC gives your product longer life and brighter appearance. Color choices range from clear IRIDITE to olive drab, plus colored dye finishes.

IRIDITE is the tradename for a specialized line of chromate conversion coatings that can be applied to any non-ferrous metal by brush, dip or spray methods—at room temperatures—manually or with automatic equipment. Upon application, a thin film forms which becomes an integral part of the metal itself, and thus cannot chip, flake or peel. No special equipment, exhaust systems or specially trained personnel are required.

IRILAC is the tradename for a line of clear protective coatings for all metals. As safe and easy to handle as water, they may be applied by brush, dip or spray methods. No exhaust or special fire protection equipment required. Adds protection and abrasion resistance to any base metal, plated part or parts treated with electrolytic or chemical post treatments, without chemical change.

For complete technical information on IRIDITE Chromate Conversion Coatings or IRILAC Clear Protective Coatings, write for FREE TECHNICAL MANUAL. Or, see the Allied Field Engineer in your area. He's listed under "Plating Supplies" in the yellow pages.

Allied Research Products, Inc.

4004-06 EAST MONUMENT STREET • BALTIMORE 5, MARYLAND
BRANCH PLANT: 400 MIDLAND AVENUE • DETROIT 3, MICHIGAN
West Coast Licensee for Process Chemicals: L. H. Butcher Co. • European Agent: Sture Gronberger, Storgatan 10, Stockholm, Sweden

Chemical and Electro chemical Processes, Anodes, Rectifiers, Equipment and Supplies for Metal Finishing

IRIDITE® Chromates | IRILAC® Coatings | ISOBRITE® Brighteners | ARP® Supplies | WAGNER Equipment

almost twice the life and in many cases more than three times the life span, it is claimed.

For best results it is usually sprayed on grinding wheels and belts or applied with a swab. Where large flat surfaces are to be finished, such as those done on automatic machines or work to be smoothened or ground down with an abrasive disc, the surface of the work piece is moistened instead of the abrasive surface.

The product can be used for any finish on any metal with the appropriate abrasive, generally with a grit one step finer.

Vibratory Finisher

Lord Chem. & Equip. Div., Wheelabrator Corp., Dept. MF, 2068 S. Queen St., York, Pa.

A new 1 cu. ft. vibratory finisher can be tilted for rinsing while still vibrating. A rinse cover, with a manifold system of spraying the water throughout the work is included with the machine.

Designated the HD-1016, the new model is 10″ wide, 16″ long and 13″ deep, with ½″-thick rubber lining throughout. The machine contains a variable amplitude shaft, adjustable from 0-¼″ amplitude. The frequency is variable within a range of 700 to 2100 cycles per minute.

The vibrator is driven by a 2 h.p., 1800 r.p.m., 220/440 or 550 volt, 3-phase, 60-cycle motor, controlled by a 3-station push button switch. The reversing starter enclosure contains a control transformer that reduces voltage on the push button station to 110 volts regardless of the power supply to the machine. The pivot point of the bowl has been located near the center of the bowl ends to permit manual tilting with little effort. The vibrating member is suspended on four coil springs.

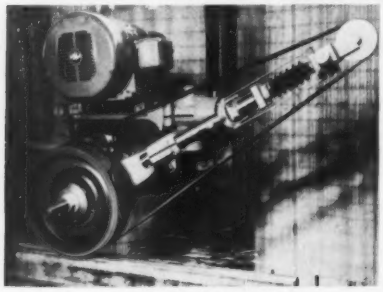
Tank Linings

General Tire & Rubber Co., Bolta Products Div., Dept. MF, Lawrence, Mass.

All standard Boltaron PVC sheeting with the exception of the polyolefins are now available with a factory applied cement-receptive coating, thereby eliminating the need for lengthy, multiple surface preparations. Cements need only be applied to the substrate of the fabrications to make a solid bond, free of cold flow.

Abrasive Belt Arm Attachment

Acme Mfg. Co., Dept. MF, 1400 E. Nine Mile Road, Detroit 20, Mich.



A new abrasive belt arm attachment can be easily installed on adjustable buffing lathes of various makes to provide an economical means of adding abrasive belt polishing operations to existing equipment and to increase flexibility of production finishing operations.

The lightweight belt arm attachment is easily mounted on the spindle housing of buffing lathes. The belts are spring loaded between a contact wheel and an idler pulley. A spring loaded lever permits rapid and easy belt changing. Tracking of the belt is achieved through an easy adjustable mechanical device.

Various standard belt arm attachments will handle belts from 2-in. up to 8-in. in width and 96-in. up to 132-inches long. The belt arm attachments can also be arranged to adapt other specific belt lengths.

Rust Preventive Cleaner

Kerns United Corp., Dept. MF, 2659 E. 95th St., Chicago 17, Ill.

Alkaline Rust Preventive Cleaner K-6882 has excellent cleaning properties and also imparts an adequate film for rust protection. Further, it will not stain machined parts and is extremely easy to control, it is claimed. Test reports from the field prove it excellent for use in shops utilizing alkaline power washer equipment to clean shop oils and shop dirt from parts which require storage prior to assembly or further machining operations.

Phosphate Conversion Coating

Diversey Corp., Dept. MF, 1820 W. Roscoe St., Chicago 13, Ill.

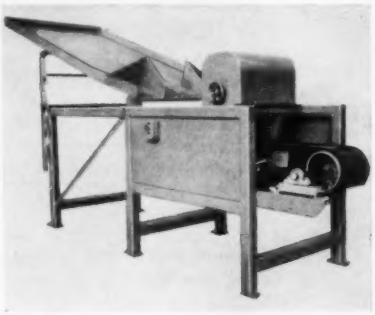
A new phosphating process that deposits a heavy, crystalline, zinc phosphate coating on iron and steel, Diverfos Z-1 performs equally well in soak or spray operations. It is specially formulated to keep sludge formation at a minimum.

In spray washer operations, coatings weighing from 150 to 300 milligrams per square foot are produced. Soak tank processing produces coatings weighing 300 to 600 milligrams per square foot. The resultant coating, which has a uniform texture and dark steel-gray color, conforms to Specification MIL C-490, Grade I Process.

Magnetic Separator

Rampe Mfg. Co., Dept. MF, 14915 Woodworth Ave., Cleveland 10, Ohio.

High-speed, mechanical separating of ferrous parts from finishing media can be achieved with this magnetic parts separating machine. It entirely eliminates hand-picking or screening and has a variable speed output. Separation is accomplished by a permanent drum-type magnet which pulls the parts up and out of the media mixture, depositing the parts on a moving conveyor belt for demagnetizing and delivery.



Two types are available: (1) a completely integrated, hopper loaded magnetic separator machine, as illustrated, and (2) an attachable magnetic separator for use as an added accessory with existing screen separators.

The complete unit Model MS-12U has a feed chute capacity of 12 cu. ft., belt speed of 70 to 124 f.p.m., and is available in 12″ or 9″ belt width. The machine measures 130″ long overall, 50″ in height including hopper, and is 37½″ wide.

Burnishing Compound

Delta Chem. Corp., Dept. MF, 2885 Warford Place, Memphis 8, Tenn.

ForemosT F-054 Compound is a mild, highly buffered, powdered product formulated to maintain the proper chemical condition necessary in burnishing operations. This specialized compound provides the desirable degree of lubrication between the work being burnished and the media within the barrel, resulting in a bright luster on metal surfaces.

This compound is said to possess a long solution life, controlled pH, and free-rinsability. It is recommended for all conventional types of burnishing equipment, with all types of media. It is specifically designed for aluminum castings and other non-ferrous metals; however, it also finds application in many operations involving ferrous metals.

Automatic Spray Nozzle

Spraying Systems Co., Dept. MF, 3245 Randolph St., Bellwood, Ill.

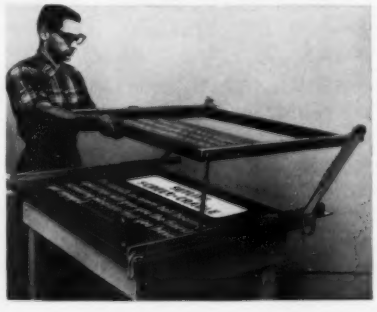
The new 8651¼JAUH automatic hydraulic spray nozzle has the unusual feature of a clean-out needle that automatically clears the orifice with each on-and-off cycle of the nozzle. This is done by means of a clean-out needle extension of the orifice shut-off valve. Each time the valve closes, the clean-out needle moves through the orifice opening to clear out any solid residue that might otherwise adhere. Compressed air is used to actuate the valve. The precision air cylinder actuating mechanism may be operated at any speed up to 180 cycles per minute.

The nozzles are supplied in a choice of interchangeable orifice tips.

Silk Screen Cradle

C. G. Sutliff Co., Dept. MF, 106-1 Benedict Ave., Syracuse 5, N. Y.

A new precision-made, patented screen cradle with ball bearing action is said to insure accurate register in short-run silk screen printing since, when the screen is in printing position, there is absolutely no play in any direction. The cradle is quickly adjustable to hold any size screen from 6″ x 6″ to the largest practical sizes. It is so designed that the screen is level in the raised position as well as in the printing position, thus preventing the



paint from running off the back of the screen.

Industrial Brushes

Osborn Mfg. Co., Dept. MF, 5401 Hamilton Ave., Cleveland, Ohio.

The new KEB wire brushes, equipped with removable bridles, compress the brush face for a greater cut and reduce flare. They are especially designed for use on high speed air and electric tools.

The bridle feature of the new line is easily removable after partial brush wear. The brushes are available in 2½, 3½, 4 and 5-inch diameters and a wide range of wire sizes.

Ultrasonic Loaded Tote Box Cleaner

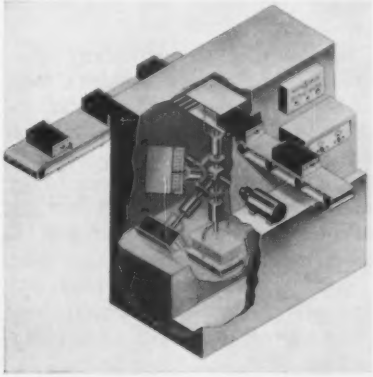
Autosonics, Inc., Dept. MF, 4217 Chestnut St., Philadelphia 4, Pa.

A new machine to load, ultrasonically clean and degrease, dry, and unload tote-box loads of metal parts, the V-72 is fully automated and requires no operator. It is particularly efficient for delicate assemblies and parts that cannot tolerate impingement or tumbling.

The new process immerses individual loads of metal parts or assemblies in a degreasing solution powered by ultrasonics, rinses with pure distillate spray and vapor, drains, and finally passes them through a free-board drying stage before discharging. Chips, oil, and other contaminants are removed even in the case of machined castings with blind passages. The tote box is cleaned at the same time as its contents.

After completion of the process the tote-box is returned to the load-unload point, and discharged onto a conveyor as the next tote-box is locked into place. Six tote boxes are handled in the various stages of the machine's operation at any given time.

Standard floor space for the machine is approximately 6′ x 10′ for most applications. Entirely odorless due to special sealing arrangements to prevent odor escape and minimize solvent consumption, the machine features its own solvent purifying by distillation. Drying facilities for water can be added. Installation requires only connection to utilities, with no external exhausting required.

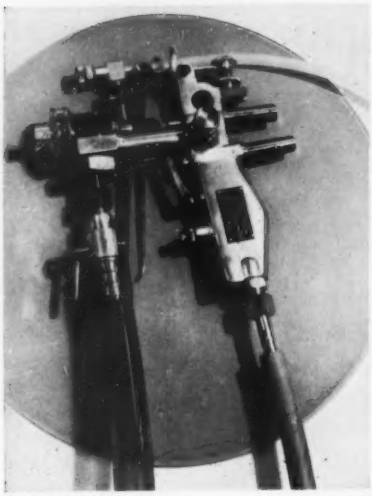


The design can process two to four tote-box loads per minute using either solvents or water solutions.

Two-Component Spray Gun

Naftone, Inc., Dept. MF, 425 Park Ave., New York 22, N. Y.

The Zippel two-component catalyst gun and complete apparatus features a unique spray nozzle which is a small pipe centrally located within a larger pipe. There is no opportunity for ingredients to mix in the gun, as blending takes place outside of the nozzle tip. The spray gun is precision made and weighs only one and one-half



pounds, which makes it easy to use for prolonged periods.

A visible feed system gives positive proof that the proper ratio of polyester to peroxide is accurately maintained. Air pressure is used over the two-components to assist flow to the spray gun. This allows the use of thixotropic and pigmented finishes and makes it possible to use lower air pressure at the gun. Adjustments are easily made at the gun to insure proper feed.

Other catalyst systems can be used in the apparatus as well as polyesters. The whole equipment can be made portable as an inexpensive rack with wheels will suffice.

Aluminum Desmutter

Diversey Corp., Dept. MF, 1820 W. Roscoe St., Chicago 13, Ill.

A new aluminum desmutter said to be effective on "problem" alloys as well as others, No. 596, may be used for desmutting all aluminum alloys, and for preparing aluminum that is to receive a conversion coating, bright dip, or anodizing. It is particularly effective on alloy 6061.

Field experience reported by the manufacturer indicates that 4 to 6 oz./gal. with 5 per cent (by volume) sulfuric acid is completely satisfactory for most aluminum alloys. Higher concentrations are used only for particularly troublesome alloys or when maximum desmutting speed is essential.

Sequestrants

A. E. Staley Mfg. Co., Dept. MF, Decatur, Ill.

Two new "Seqlene" brand sequestrants are especially effective in sequestering iron from strongly alkaline solutions. Fe-900 and Fe-1300 are water solutions composed chiefly of sodium beta-glucoheptonate. They differ only in solids, Fe-900 having about 35 per cent solids, and Fe-1300, 50 per cent.

Because they are particularly effective in strong alkaline solutions, these sequestrants have found popular application in the general fields of alkaline derusting and cleaning, and in treating hard or rusty water. They effectively sequester not only iron but calcium and magnesium, as well as other metal ions such as aluminum, copper, nickel, manganese, cobalt, zinc and silver. They are generally used alone with alkali, or with alkali plus a wetting agent.

BUSINESS ITEMS

Pennsalt Sales Technical Service Groups in New Quarters

Pennsalt Chemicals Corp. has announced the transfer of its sales technical service groups to new and expanded laboratory facilities at 900 First Ave., King of Prussia, Pa. These groups were previously located at the firm's Whitemarsh Research Laboratories, Wyndmoor, Pa. and at Devon, Pa. The move centralizes all groups providing technical customer services.

as reinforcement. By using a special process obviating costly molds, the firm is able to fabricate specific dimensions at nominal cost.

Riegel Names Crown Chemical West Coast Buff Distributor

Crown Chemical and Engineering Co., with offices in Los Angeles and San Francisco, has been appointed exclusive west coast distributor for the Bias Buff Division of *Riegel Textile Corp.* Crown will stock the line in depth, carrying adequate inventory, and also will be fully equipped to analyze buff problems for industrial users.

Crown has two fully staffed offices in California; one at 4722 Worth St., Los Angeles; the other in San Francisco, located at 2160 Palou Ave.

Three District Sales Managers Appointed by Kelite

The appointment of three district sales managers has been announced by *Kelite Corporation*, manufacturer of metal processing chemicals, industrial cleaning compositions, and steam cleaning equipment.

John E. O'Brien is now New York district sales manager. He was Philadelphia district sales manager for four years. Mr. O'Brien will have headquarters in the Berkeley Heights, N. J., facility and will oversee sales in New England, New York, and New Jersey. He is a member of the A.E.S., Philadelphia Branch.

William J. Hennessy is now Philadelphia district sales manager, supervising sales in Eastern Pennsylvania, Southern New Jersey, Delaware, Washington, D. C., Maryland, and Virginia.

John E. O'Brien

The new building, a two-story, 31,000 square foot customer service laboratory, is the first unit to be completed in the company's planned $6,000,000 technical center. This center will be located on a 50-acre site in King of Prussia Industrial Park.

New Metal Finishing Equipment Company Formed

A new firm, *Plateq Corp.*, manufacturers of metal finishing equipment, has been formed by *M. Ladutka* and *K. D. Miller*. The firm, located at 657 First Ave., West Haven, Conn., will bring to the industry a new source for all types of equipment and supplies required by large industrial platers as well as job shops in Connecticut and the northeastern United States.

Mr. Ladutka, who has been named president of the new firm, is also president of The New Haven Specialty Mfg. Co. Mr. Miller, former chief engineer of Enthone, Inc., and now vice president of Plateq, has been active in the plating equipment industry for many years.

Brucar to Fabricate Fiberglass Tanks

Brucar Equipment and Supply Co., Inc. of Long Island, N. Y., is now manufacturing fiberglass tanks and exhaust systems, fabricated from highly corrosive-resistant resin, utilizing glass

William J. Hennessy

Clifford A. DeMeritt

He was formerly product development manager and has been with the firm five years. He is a member of the A.E.S., and is a past president of the Pittsburgh Branch.

Clifford A. DeMeritt is now in charge of the Orlando district, which consists of the southeastern states of North and South Carolina, Alabama, Georgia, Tennessee, and Florida. Mr. DeMeritt has been a company sales engineer for four years. He, too, is a member of the A. E. S.

Carborundum to Build Plant in Australia

The *Carborundum Co.* will construct a million dollar coated abrasive manufacturing plant in Melbourne, Australia, to be equipped with the most advanced facilities in the coated abrasive industry, and designed to meet the growing demand for coated abrasives in Australia and New Zealand.

Carborundum Australasia Pty. Ltd., a subsidiary, now operates a plant in Sydney, Australia. Its manufacturing operations will be transferred to the new Melbourne plant when it is completed in late 1961.

O'Brien Corp. Appoints Marcotte

The appointment of *Thomas F. Marcotte*, formerly of Louisville, Ky., to the industrial division of *The O'Brien Corp.* laboratory was announced recently. His immediate assignment will be research and development of industrial enamels, particularly for metal appliances. He has had twelve years' experience in this field prior to coming to South Bend.

Marcotte is a graduate of the University of Louisville where he majored in chemistry.

Stokes Establishes British Subsidiary

Incorporation of *F. J. Stokes Limited*, with headquarters in London, has been announced by the parent company. Directors of the new subsidiary are *Allan A. Hutchings*, vice-president in charge of sales, and *F. Joseph Stokes, Jr.*, vice-president in charge of manufacturing for the American company, and *Malcolm Scott* of London.

James T. Davies, an Englishman and a former sales engineering executive of the American company, has returned to London to undertake the general management of operations. He will direct production, sales and on-the-spot technical service throughout the United Kingdom.

Cunningham Joins Sales Staff at J. O. Ross

Denver Cunningham has recently joined the sales engineering department at J. O. Ross Engineering Div., *Midland-Ross Corp.* He has a wide background of experience in the textile and chemical fields and, until recently, was Atlanta regional sales manager of Proctor and Schwartz Co. He will headquarter in the Atlanta office.

Pittsburgh Plate Appoints Keck Technical Director

Appointment of *David M. Keck* as technical director for the Houston, Texas, paint factory of *Pittsburgh Plate Glass Co.'s* paint and brush division, was announced recently. He succeeds *Otto J. Hartwick*, who has retired after completing 32 years of service with the company. Mr. Keck had served as assistant technical director since his transfer to Houston during 1960.

Mr. Keck joined the firm in 1947 as a chemist at its Springdale, Pa., paint factory and, in 1957, was named technical director for the Suydam paint factory in Pittsburgh. He is a graduate of Pennsylvania State University and a member of the American Chemical Society and Federation of Societies for Paint Technology.

Dow Establishes Metals Department

Formation of a new Metals Department in *The Dow Chemical Company* was announced recently. *W. J. Rave*, manager of magnesium production in the Texas Division, has been named manager of the new department. *Hilary A. Humble* has been appointed sales manager.

Rave, who will transfer soon to Midland, has been manager of magnesium

W. J. Rave

H. A. Humble

production in the Texas Division for the past 10 years. He joined the firm in 1940. Humble, who has been working as a product sales manager in Magnesium Sales, joined Ethyl-Dow Chem. Co. in 1933. He has been in sales work since 1949.

Management Changes at North American Mogul Products Co.

At a recent meeting of the board of directors of the *North American Mogul Prod. Co.,* industrial water treatment firm, Cleveland, Ohio, announcement was made of the formation of a new executive and management group.

Arthur W. Pugsley, president of the company since 1951, was named chairman of the board. *C. Carlisle Tippit*, now vice-president and treasurer, will become the new president and treasurer. *R. H. Mohrman* and *E. R. Strunk* will retain their present positions as executive vice-president and secretary, respectively.

Two new vice-presidential appointments were also made at this time. *William T. Sullivan*, director of sales and marketing, was named vice-president/sales and marketing. *George P. Loomis, Jr.* was elevated from director of service and development to vice-president-customer service and development. *Stiles B. Twitchell* was appointed as technical sales director.

Blackstone Corp. Announces Organizational Changes

Blackstone Corp., Jamestown, N. Y., has announced a number of organizational changes in the Ultrasonics Division as well as increased research and development and production facilities.

John A. Antonevich has been appointed director of ultrasonic research and development. He is a 1950 graduate of Marquette University with a degree in Electrical Engineering. He has been associated with the Kearney and Trecker Corp., West Allis, Wis., and John Oster Mfg. Co. of Racine, Wis. For the past seven years he was associated with Battelle Memorial Institute at Columbus, Ohio as principal electrical engineer.

Robert H. Swick has been appointed product engineer in research and development. He is a graduate of Washington and Jefferson University with a major in physics, and minors in chemistry and mathematics.

Gordon L. Johnson has been transferred to the division to become product engineer. Previously he was a methods engineer with the manufacturing division. He attended Indiana Technical College majoring in electrical engineering.

Gail Gustafson who has been in sales with the division since 1957, will now devote full time to directing sales activities of 17 manufacturers representatives and other sales outlets such as laboratory supply houses and specialized distributors. He is a graduate of Cincinnati University.

Concurrently with these organizational changes, both research and development and production facilities are being expanded. The operations of


John A. Antonevich


Robert H. Swick


Gordon L. Johnson


Gail R. Gustafson

Murdoch Laboratories Division have been transferred from Port Washington, N. Y., to the home office at Jamestown, and will be known as the research and development department of the Ultrasonics Division.

General Finishing and Spraying Succeeds General Sprayers, Inc.

General Finishing and Spraying Co., Inc., Newark, N. J., announces the acquisition of the paint spraying business formerly owned by *General Sprayers, Inc.* The same experienced personnel and modern production facilities will be maintained to assure prompt service. *Walter Paterson* will be retained in the capacity of general manager. It is the plan of General Finishing and Spraying to expand their finishing services in paint spraying and finishing to government and commercial specifications.

H-VW-M Appoints Sickles

Hanson - Van Winkle - Munning Co. has announced the appointment of *Ralph E. Sickles* as field electrochemist. He will be headquartered at the Cleveland office.

Prior to joining the firm, Mr. Sickles had for five years been an engineer and electrochemist in the process and development section of a large rubber company. From 1952 to 1955 he was chief chemist for a far western steel fabricator and for five years prior to 1951 he was an analytical chemist with

Ralph E. Sickles

one of the nation's largest steel companies.

A Kent University graduate, Mr. Sickles also attended Mississippi College. During World War II he served with the Army Air Force.

Osborn Manufacturing Names Fisher Manager of Finishing-Machine Sales

Osborn Mfg. Co., 5401 Hamilton Ave., N.E., Cleveland, Ohio, has announced the appointment of *Edward P. Fisher* as manager, finishing machine sales. A graduate of Marquette University, he was assistant manager of industrial sales prior to his new appointment.

Mr. Fisher joined the company in 1946 as a research and development department project engineer, and was a sales engineer before becoming assistant manager of industrial sales. He is a former U. S. Navy officer and member of many engineering societies.

Partswash Equipment in New Location

Partswash Equipment Co. has moved its main office, warehouse and repair shop, formerly located in West Hartford, to 150 Willard Ave., Newington, Conn. The telephone number is ADams 2-1770.

Garland Joins Frederic B. Stevens, Inc.

The Metal Finishing Division of *Frederic B. Stevens, Inc.*, Detroit, announces the appointment of *James Garland* as a sales representative for Western Pennsylvania. Before joining the firm, he was employed for nine years as department head of analytical

James Garland

chemistry at The Coraopolis Division of Rockwell Standard Co.

Mr. Garland is a graduate of the University of Pittsburgh and holds a Bachelor of Science degree in Chemistry. During World War II he served with the Air Force in The Mariannas Islands. He is a member of the A.E.S. and N.A.C.E.

Wheelabrator Division Reports Name Change, Personnel Shifts

The former *Lord Chemical Corp.*, York, Pa., will now be known as Lord Chem. and Equip. Div. of *Wheelabrator Corp.*, Mishawaka, Ind. The division will continue its manufacture of precision finishing equipment, media and compounds in York and in Red Lion, Pa. The Lorco name will now apply to all products of this division. Previously, barrel finishing and wet blast models were identified as Techline products, as were media and compounds for barrel finishing and abrasives for wet blasting.

Machu Joins Amchem

Prof. Willibald Machu, renowned authority on metalworking conversion coating chemicals and finishes, has joined *Amchem S. A.*, a new wholly owned European subsidiary of *Amchem Products, Inc.*, Ambler, Pa., as patent attorney and special technical advisor-in-residence to European licencees. Dr. Machu, a chemical engineer, will make his headquarters in Vienna, Austria, where he will also engage in extensive research projects.

Prof. Machu comes directly from Cairo University, Cairo, Egypt, where he had been professor of inorganic chemical technology from 1950 to 1953. In the latter year he became head of the mining department of the University, as well as professor of metallurgy, until December 1960 when he resigned to join the firm.

Pioneer Reps. Discuss Sales Campaign

Representatives for the *Pioneer Rubber Co.'s* Industrial Glove Division met for a sales seminar at the Conrad Hilton Hotel in Chicago recently.

Left to right: *Andy Yonis*, New York City; *True E. Read*, Special field representative; *Al Marshall*, Dallas; *Jim Alpine*, Ashtabula, Ohio; *John R. Jones; Mrs. Alice Williams; J. H. Gibson; Jack Knight*, Chicago, and *Bill Casselman*, Los Angeles.

Azzarello New Sales Promotion Manager at Binks

Appointment of *Charles Azzarello* to the position of sales promotion manager has been announced by *Binks Mfg. Co.* In his new position, he will be responsible for all phases of sales promotion of the company's standard equipment line and industrial products. In addition to his normal sales promotion duties, Mr. Azzarello will work in the field with business and trade shows, industrial exhibits, sales clinics, and similar activities. He will work closely with the automotive service industries and paint manufacturers.

Mr. Azzarello has been with the company since 1951. Much of his time was spent in sales, and he was former-

Robert J. Schlosser

manager of the new division.

The firm has installed fully instrumented equipment of advanced design to manufacture buffing compositions on the West Coast under exclusive license from Lea Mfg. Co. of Waterbury, Conn. A full line is available to the metal and plastic processing trade, including Behr-Manning belts and Riegel buffs and wheels.

Formation of Wheelabrator Corp. of Canada, Ltd. Announced

Formation of a new Canadian company, *Wheelabrator Corp. of Canada, Ltd.*, was announced recently. The new corporation is the successor to the Canadian Division of *Wheelabrator Corp.* of Mishawaka, Ind., and was organized to handle expanding sales and fabricating activities for all provinces in Canada.

Harold M. Miller is president and *Robert A. Campbell* is vice-president and general manager and is in charge of Canadian operations. *J. D. Lamb* is general sales manager. Other officers are *Jacob A. Schmidt, Jr.*, vice-president; *Edward T. Sullivan*, secretary and treasurer; and *James E. Donlan*, controller.

American-Marietta Appoints Sauer for North Carolina Div.

Recently appointed trade sales manager for the *Marietta Paint & Color Co.* in High Point, N. C., *Bud Sauer* will supervise sales in this eastern area.

For ten years prior to his new association, Mr. Sauer was southeastern district sales manager for Minnesota Paints, Inc., of Atlanta. Before that, he was affiliated with Lowe Bros. Paint Co.

Charles Azzarello

ly assistant manager of the company's St. Louis branch. His formal training includes a degree in marketing and advertising.

Mr. Azzarello will work out of the main office, located at 3114 Carroll Ave., Chicago 12, Ill.

Crown Chemical & Engineering Forms New Division

Crown Chemical and Engineering Co. announces the formation of a new division of the company to specialize in supplies and equipment for the polishing and buffing industry. *Robert J. Schlosser*, prominent industrial applications engineer for the Behr-Manning Co. in the Southern California area for the last ten years, is sales

Bud Sauer

A graduate of the University of Cincinnati with U. S. Army service in the Ranger Battalion, Mr. Sauer now resides in Greensboro, N. C.

Eysman New President of Cellofilm

The board of directors of *Cellofilm Industries, Inc.*, have appointed *Stanley Eysman* as president. Associated with the firm for many years, Mr. Eysman previously held the position of vice-president in charge of sales. He is well known in the chemical and industrial coating fields.

The company is the largest independent producer of nitrocellulose solutions which are used in the manufacture of lacquers and other products.

John E. Rowe Honored at Binks Awards Dinner

John E. Rowe, vice-president and a member of the board of directors of *Binks Mfg. Co.*, Chicago, was honored recently for his 25 years of outstanding service to the company, a leading designer and manufacturer of spray finishing equipment and water cooling towers.

At a dinner given in Chicago's Drake Hotel, Rowe was presented a diamond studded engraved key chain by *Burke B. Roche*, company president.

Wepco Expands Facilities

Completion of major construction on its plant expansion has been announced by *W. E. Pipkorn Mfg. Co.*, maker of formed wire products, custom wire fabrications and production aids. The expanded plant is located at 2211 West County Road D, St. Paul 12, Minn.

Tramer Appoints Nordstrom

Gilbert Tramer Co. announces the appointment of *Dan H. Nordstrom* of Ft. Worth, Texas, as representative in the states of Texas, Arkansas, Louisiana, and the Oklahoma territory.

Mr. Nordstrom started his early schooling in Chicago and later attended Illinois Tech. During World War II he served in the Army Air Force. After considerable experience with various aluminum finishing fabricators he became a manufacturer's representative in 1953.

Mr. Nordstrom will specialize in complete finishing, chemical treating, and anodizing installations.

Dan H. Nordstrom

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

Ladies Program a Feature of Boston Convention June 18-22

Mrs. George Swift
Ladies Chairman

In the March issue we mentioned the all-day symposium on Finishing of Light Metals, the plant visitations, and other events of interest to the men. This month we will give a few details on events planned for the women and children by *Mrs. George Swift*, chairman of the Ladies' Committee, starting with a tea on Sunday in the Georgian Room of the Statler Hilton from 3:00 to 5:00 p.m. The ladies will join the men later in the evening for the get-acquainted reception.

Mrs. George Marotta
Children's Chairman

On Monday there will be a luncheon at the Statler Hilton for all lady registrants, with *Robert C. Trees* of *The Udylite Corp.* as host. In the evening the *Metal Finishing Suppliers' Association* will again host the MFSA Ball, a popular feature at every convention.

M. E. Baker Co., Lea Manufacturing Co. and *Lea-Ronal, Inc.* will sponsor the luncheon to be held on Tuesday at the famous Crane Castle in Ipswich, Mass., after which the ladies will go on a tour of the North shore region, Cape Ann, Gloucester, etc. The entire convention is invited to attend a Boston Pops Concert at Symphony Hall in the evening.

A clambake near Plymouth is the main event for all the conventioneers on Wednesday, plus an evening program at the Statler Hilton.

Thursday will be a busy day, with a tour of historic Boston to start out the day, followed by a luncheon in the Dorothy Quincy Suite of the John Hancock Building, at which the *Sel-Rex Corp.* will be the host. There will also be a talk on "Gold and Man," to be illustrated with oil painting. As usual, the convention will wind up that evening with a gala banquet and entertainment.

Since accommodations at the Statler are limited, it is suggested that reservations be made at once.

Buffalo Branch

The Branch held its monthly meeting on Friday, Feb. 3rd, at the Niagara Manor, Buffalo, N. Y., with 24 members in attendance. President *Harold Shapiro* called the meeting to order and introduced the guest of the evening, *Ivan Kerzner. Jack Martin*, who recently recovered from an ankle injury, thanked the branch members for the basket of fruit sent him.

George Wolf, the Technical Societies representative, advised that to date the Branch has been credited with three exhibition booths for the forthcoming Science Fair. Mr. Wolf asked for volunteers in contacting manufacturers relative to subscribing for Science Fair booths.

Mr. Shapiro announced the May meeting will be held May 12th due to the Rochester Regional meeting May 5 and 6. Librarian *John Tiebor* introduced the speaker of the evening, *Dr.*

Hyman Chessin of Van der Horst Corp. of America, who with the aid of slides, presented a very informative talk entitled "Adhesion of Electroplated Metals."

Following a question and answer period, and a rising vote of thanks for the speaker, Mr. Shapiro closed the meeting.

British Columbia Branch

The regular monthly meeting was held on Thursday, February 16th, at the Lougheed Hotel, North Burnaby, B. C. Twenty-four members and guests attended.

Following cocktails and dinner the meeting commenced at 8:15 P.M. with *Gordon Smith*, president, in the chair. The guest speaker of the evening was *Alex Bartholomew*, director of sales, Behr-Manning Co. of Canada Ltd., who presented a very interesting and informative discourse on the use of abrasives in job shop polishing. This was followed by a thirty minute film on the topic. A lively question and answer session followed.

C. Schlossareck,
Secretary

Chicago Branch

The regular meeting was held at Petricca's Restaurant, 510 North Western Ave. on Friday, February 10. One application for membership was received and five applications were approved by the board of managers. *Jerry Glab*, in the absence of *Paul Glab*, read the two announcements received by the branch. The first concerned a paper to be presented at the National Convention concerning "Cost Savings Idea for Finishing." The second was that the Chicago Area Career Conference is looking for a speaker to give a paper on a topic to be chosen by the conference committee. There is still a need for an up-to-date roster of the members of the Branch as suggested by librarian *Si Gary*.

Mr. Gary introduced *Burt Allen*, of McGean Chem. Co., who acted as moderator for the panel of the following members: *Raymond Goodsell*, Racine Plating Co.; *Tom Lazzarotto*, Specified Plating Co.; and *C. A. Oswald*, of Westergaard Plating Co. The subject was "Operating a Hoist Line Efficiently." Each member discussed briefly the hoist line operations that was used for plating in their respective plant.

A lively question and answer period followed and the panel members were given a rising vote of thanks.

Christopher Marzano,
Publicity Chairman

Dallas-Fort Worth Branch

The February meeting was held in the Banquet Room at the Howard Johnson Turnpike Inn on Wednesday, February 15, first V.P. *Fred Howard* presiding. An enthusiastic gathering of members and guests, nearing 40, enjoined a friendly Fellowship Hour prior to one of the most informative meetings in a long time. Branch business items included the voting-in of two new candidates for membership and the welcoming of *Al Jocis*, a recent transfer from "Yankee-land." The Honorary Texan Award went to *Al Korbelak*, who had completed two successful visits to the Lone Star State in speaking engagements. Voting of the Branch indicated that *Milt Davison* was the unanimous choice for branch treasurer.

Secretary *A. C. Fricke* announced that 2nd V.P. *D. L. "Don" Allie* was absent for good reason. Don was delegated by the Branch Executive Committee to attend the A.E.S. Interim Meeting in Hartford to announce the Dallas-Ft. Worth's interest in securing the 1967 National Convention. Mr. Howard called on *M. E. Browning* to present the committee report on the Southwest Regional Activities. Browning gave a brief status report and announced the completion of regional membership promotional plans, which have been in work for some months.

Mr. Davison reported that Project No. 20 was in the final stages of negotiation with *Dr. R. L. Hoyle*, of Arlington State Univ., selected as research fellow. Mr. Browing reported on the Teachers Scholarship Fund work being supported by the Dallas-Fort Worth A.E.S. as part of their participation in the Dallas-Ft. Worth Council of Scientific Societies.

Two local organic finishing authorities, *A. E. Hohman* of Chance-Vought Aircraft and *O. W. Byrnes*, Convair, were introduced as visitors.

Mr. Howard introduced the guest speaker, *Al Korbelak*, who spoke on "New Methods in Precious Metal Plating." Mr. Korbelak presented a very informative talk dealing primarily with plating of electronic components. Some of the new techniques, especially new barrel concepts, necessary to plate mul-

ti-gang headers in great volumes were very interesting. Mr. Korbelak used slides and a sound-color movie to illustrate his presentation.

After a lively question and answer session, *Doug Cox* made a motion that the meeting be adjourned.

Jack Haler,
Recording Secretary

Newark Branch

Due to the absence of the president and both vice presidents, Librarian *Cy LaManna* acted as president. He called the meeting to order at 8:45 p.m. on Feb. 17, at the Robert Treat, with about 80 members and guests present. Three applications were received. *C. Lewis Wellington* of Wellington Electronics was elected to membership. *Edward Bezursik* transferred into the Branch from Hartford.

Fred Meyer, chairman of the nominating committee, was called upon for his report, which was as follows: For president, *Al Korbelak;* for first vice-president, *John Kosmos;* for second vice-president, *Cy LaManna;* for secretary, *Don Foulke;* for treasurer, *George Wagner;* for librarian, *Gene Wagner;* for sergeant-at-arms, *Mario DiChiara;* for board of managers, *T. Austin, W. Grigat, F. Meyer, G. Reuter* and *G. Bittrich;* for delegates, *D. Foulke, A. Wesley* and *G. Wagner;* for alternate delegates, *W. Grigat, A. Korbelak* and *F. J. LaManna.*

George Shaw was called upon for his Timely Topic, which was "Ultrasonics in Plating." He discussed, in general terms, the use of ultrasonics both in cleaning and plating cycles and how far the art had advanced. *Dr. Edward Saubestre* then spoke on "Plating on Non-Metallics." In addition, he discussed how and why electroless plating baths function as they do, giving many practical hints and timely ideas. Both speakers covered their subjects very well. They created much interest as attested by the numerous questions asked of them.

Gustav Bittrich,
Assistant Secretary

Phoenix Branch

The February meeting was held at the Arizona Ranch House Inn at 5614 North Central Ave. After an excellent dinner of Chicken Coc-Au-Vin, *Floyd Huhn*, president, called the meeting to order. Two guests were welcomed, *Donald Bondi* of Enthone and *Ralph Ponce De Leon* of Motorola. *Bob Hays*, branch librarian and symposium chairman, reported on the progress of the 2nd Annual Spring Symposium.

Mr. Hays introduced *Charles Wilsterman* of Deer-O-Paint Ltd., who gave a most interesting talk on paint and paint processes. The meeting was adjourned at 9:30 p.m.

Paul M. Wible,
Secretary

Rochester Branch

The Branch held its February 6 meeting at the Rochester German Club. Various reports were given on the coming Regional Meeting and Golden Anniversary Celebration to be held at the Manger Hotel on May 5th and 6th.

Frank Beuckman announced that the speakers were confirmed as follows: *King Ruhly,* Michigan Chrome and Chem. Co., "Fluidized Bed Coatings"; *Scott Modjeska,* Scientific Control Laboratories, "Plating on Uncommon Metals"; *David Miller,* Deering Milliken, Inc., "Presentation on Buffing Fabrics."

The women will be entertained at a luncheon in the Manger Hotel while the men attend the educational session.

Jack Pandina was appointed chairman of the nominating committee for the coming election of officers.

After the business meeting, librarian *Loring F. Carson* introduced *A. D. Squitero* of the International Nickel Co. as speaker of the evening. His subject, "Industrial Nickel Plating," covered the physical, mechanical and chemical properties of nickel, as well as various applications of industrial nickel plating. Mr. Squitero's most interesting talk was well illustrated by several slides, some showing castings of several tons being plated outside of the plating plant because of their huge size.

Peter VanDilst,
Secretary

Los Angeles Branch

Ultrasonic principles as they apply to the electroplating industry, detergents and related fields was the subject of a talk presented at the Feb. 8 meeting by *Thomas Krueger,* an engineer affiliated with Acoustica Associates, Inc., of Los Angeles.

President *Frank Virgil* presided over a half hour business meeting which preceded the educational session. He directed the initiation of *Robert Shinning* and *Richard Kernel* into membership, and announced the approval of membership transfer of *Robert Helber* from St. Louis Branch to Los Angeles.

The nominating committee, composed of *Frank Eddy, Stuart Krentel* and *Norman McEwan,* recommended the following slate of candidates for 1961-62 officers: President, *Emmett H. Babcock;* first vice-president, *Harvey K. Hunt;* second vice-president, *Don E. Baudrand;* secretary, *Harold Wanamaker;* treasurer, *Robert Pooler;* educational chairman, *William Pardee.* Nominated for board of manager positions were out-going president *Frank Virgil, E. Truman Stoner* and *Norman Painter.*

Syracuse Branch

The February meeting consisted of a plant tour of The Solvay Process Co.'s caustic plant. This was followed by a fine dinner served in the firm's cafeteria to thirty-two members.

The meeting was called to order at seven P.M. in the company's auditorium. The speaker of the evening was *Lee Alderuccio* of the research group studying chrome plating problems. Mr. Alderuccio's subject was, "The Adhesion of Chromium Plating as Affected by Surface Preparation."

After an interesting question and answer period the meeting was adjourned at nine-thirty P.M.

Rene Sonnenfeldt,
Recording Secretary

Waterbury Branch

The Branch held its regular monthly meeting at the Roger Smith Elton Hotel on Thursday, February 9. President *Bill Giesker* called the meeting to order and announced that *William T. Gray* would be the member honored at the "Old Timers Night" affair to be held in conjunction with the Interim Meeting at the Hotel Statler on February 11.

Albert Griffith, the branch's 2nd vice president, has left the area to join the Bendix Corp., Atomic Energy Div., Kansas City, Mo. Al was secretary of the branch for several years.

The Branch voted to support the nomination of *Raymond O'Connor* of the Bridgeport Branch for national honorary member.

Technical Chairman *Fred DePalma* introduced the speaker of the evening, *Frank Schneiders,* who talked on "Adhesion" and covered the principles of obtaining adherent bonds in paint to metal, and metal to metal systems. There was considerable discussion after the presentation of the paper.

F. A. Schneiders,
Publicity

Rockford Branch

A goodly crowd of 54 members and guests attended the dinner and regular meeting held at the Faust Hotel on February 13. After the dinner, President *Harold Ellis* called for a report from the annual committee, who assured that this would be the very best program ever presented at the annual and that the banquet would be something to remember. *Al Overbey,* ticket and program chairman, offered a supply of tickets for all who wanted them.

At President Ellis's request, *Leonard Weeg* reported on the recent election of officers of the Midwestern Regional Council held at Chicago on January 28. *I. M. Weiss,* a welcome visitor from the Detroit Branch and a member of the national membership committee, briefly outlined the methods necessary to maintain a steady growth of society membership.

William Murray, manager of marketing, Enthone, Inc., the speaker of the evening, presented a very enlightening discourse on "Spotting Out and Tarnish Prevention" which, he remarked, was the subject of the very first research project of the society in conjunction with the National Bureau of Standards in 1929. He admitted, reluctantly, that to date no completely

satisfactory solution of the problem has been found and that lacquering is not the final answer. In every respect, Mr. Murray's talk was both technically informative and interesting.

Alexander Alexander,
Publicity Chairman

AMERICAN SOCIETY OF TESTING MATERIALS

Norman I. Gaynes, 48 Whitney Drive, Berkeley Heights, N. J., international consultant and technical director of *Titanine, Inc.*, Union, N. J., has been named secretary of A.S.T.M. D-1 Subcommittee XXV, succeeding *R. P. Hirt* of Hercules Powder Co.

Subcommittee XXV develops new standards and methods, which are used throughout the world in evaluating and testing all lacquer products.

Mr. Gaynes, a recognized authority on metal finishing whose papers have been published in all leading trade journals concerned with industrial finishing, will add his experience to Subcommittee XXV in coordinating the work and test results of the cooperating laboratories and groups connected with the various phases of lacquer specification development.

Norman I. Gaynes

Committee B-8 on Electrodeposited Metallic Coatings and Related Finishes has prepared for publication a series of over 200 definitions relating to electroplating of metals. These are the first definitions that have been prepared by the committee covering terms used in Society standards and in the industry.

A specification for multi-layer (duplex) electrodeposited nickel coatings has been prepared to permit standardization of these coatings for use in outdoor surfaces. Two systems are being considered for designating chromium-nickel-copper decorative coatings that will permit labeling to ensure consumer quality. One of these methods will be presented to the Society for publication at the earliest possible time.

Interlaboratory work is continuing to find the best dye for checking the sealing of anodic coatings on aluminum alloys. A specification for anodic film thickness has been completed.

Interlaboratory data on the use of magnetic flux gages to measure electrodeposited film have been reported. These data will provide a basis for revising and enlarging existing thickness test methods in the near future.

The committee will sponsor a symposium on electroforming in the near future. Those interested in participating in this symposium are urged to get in touch with *Dr. Edward B. Saubestre,* technical director, Enthone, Inc., Box 1900, New Haven 8, Conn.

NEWS FROM CALIFORNIA

Technical speakers at the annual educational session of Los Angeles Branch, A.E.S., held April 8 at the Statler - Hilton Hotel in Los Angeles, were the following: *E. C. Rinker*, vice-president and technical director, Sel-Rex Corp., Nutley, N. J., on "Space Age Precious Metal Plating"; *Dr. Frederick A. Lowenheim*, laboratory manager, Metal & Thermit Corp., Rahway, N. J., on "Alloy Plating" and *Dr. E. B. Saubestre*, technical director, Enthone Corp., New Haven, Conn., on "Electropolishing."

Miss Emily Peach, owner of Metalectro Laboratory, reports the appointment of *Robert Howard* as factory manager of the plating plant which she operates in conjunction with a metal finishing research and development facility in North Hollywood.

Miss Peach's plant is equipped to do electroless nickel, gold, silver and cadmium, and electropolishing, mainly on aircraft and electronic parts and food-handling machinery. The work of the plant also includes high emissivity coating and heat dispersal coating on missile capsules.

Miss Peach, an extremely comely young lady, invariably occasions surprise when she reveals that she has been a plating shop owner for eleven years. Her interest in plating developed when, as a child, she used "—to hang around," as she phrased it, in her father's machine shop in La Mesa, Tex., a couple of hundred miles west of Fort Worth. She became interested first in the heat treating which was done in the shop and later in plating. Subsequently she graduated in electrochemistry at the University of California, Berkeley and, in 1950, opened her own shop in the San Fernando Valley district of Los Angeles.

The third semester of a 3-section electroplating course will start on April 3rd, it has been announced by *Milton Weiner*, chemical engineer of Santa Fe Springs, Cal.

San Francisco Branch, A.E.S., presented a program well balanced with national and local speakers for appearance at the branch's first annual technical session held at the Jack Tarr Hotel in San Francisco recently.

The program was offered in forenoon and afternoon technical sessions and included the following speakers: *Edward Duffek*, chemical metallurgist, Stanford Research Institute, on "Recent Developments in Alloy Plating"; *W. J. Crehan*, manager, Kanigan Div., General American Transportation Co., Chicago, on "Applications of Electroless Nickel": *William Lidke*, L. H. Butcher Co., San Francisco, on "Some Aspects of Air Agitated Nickel Plating"; *Leo Missel*, research engineer, Lockheed Missile and Space Systems Division, on "Engineering Applications for Electroplating"; *Barnet D. Ostrow*, general manager, Lea-Ronal, Inc., on "Acid Gold Plating"; and

Paul Ignatz, Fairchild Semiconductor Corp., on "Anode Corrosion, Polarization Phenomena in Acid Copper Plating."

Forest M. Condroit of A. A. Plating Co., San Francisco, president of the branch, served as general chairman of the affair, which included daytime technical sessions and a dinner dance in the evening.

Harold B. Cleworth, formerly shop manager for Crown City Plating Co., Temple City, Calif., has joined Alert Supply Co. of Los Angeles as a sales representative in the San Fernando Valley area.

Manufacturers' Literature

Filter Systems

Sethco Mfg. Corp., Dept. MF, 2284 Labylon Turnpike, Merrick, N. Y.

One page Bulletin 802 contains complete technical description and prices of all-epoxy centrifugal filter systems designed for depth filtration of all the common acid and alkaline aqueous solutions and solvents to microscopic clarity at high-flow rates.

Bulletin 402 describes corrosion resistant stainless steel type 316 In-Line filter chambers that are piped directly into water or liquid process pressure lines.

Inspection Manual for Hot Dip Galvanized Products

American Zinc Institute, Inc., Dept. MF, 292 Madison Ave., New York 17, N. Y.

A new and definitive inspection manual, governing protective zinc coatings on products hot dip galvanized after fabrication, describes significant factors governing inspection, properties, specification, and purchasing. Comprehensively illustrated with photographs, charts, and graphs, the manual describes the galvanizing process, discussing such significant details as the metallurgical structure of zinc coatings, factors influencing adhesion, effects of various conditions of the basis metal, etc.

ASTM recommendations for zinc coating weights are listed for different types of products, and a detailed checklist for inspectors' acceptance, rejection, and recommended action, are some of the valuable material included in the manual. In addition, the book includes a section on product design and assembly in relation to hot dip galvanizing.

Spray Booth Water Treatment

Oakite Products, Inc., Dept. MF, 118 Rector St., New York 6, N. Y.

Simple directions for maintaining the efficiency of water wash paint spray booths are given in a new folder, F9443, which discusses the problems which arise from the use of untreated water, and then describes the properties that water treating compounds should have for the maximum effect on paint overspray.

The folder lists seven compounds which have proved successful in treating a wide range of organic and synthetic coatings. Tips are given on the proper application procedures and control equipment, as well as the maintenance of the spray booth system.

Organic Coatings

Red Spot Paint & Varnish Co., Inc., Dept. MF, Evansville, Ind.

A catalog made up of loose leaf type pages in a simulated leather binding is available on the above firm's coatings and colors for the vacuum metalizing and decorating industry. The first fourteen pages comprise a glossary of the terminology common to the field and cross references on first and second surfaces metalizing and decorating plastics. The balance of the book contains information on general description, instructions, availability, use, etc.

of the firm's products used for metalizing, decorating plastics, solutions and thinners.

pH Meters

Beckman Scientific and Process Instruments Div., Dept. MF, 2500 Fullerton Road, Fullerton, Calif.

Features, applications, and specifications of the Model G and GS pH meters are reported in a new descriptive bulletin.

Centrifugal Pumps

Deming Co., Dept. MF, Salem, Ohio.

Bulletin 3913 describes a new double ball bearing end suction centrifugal pump.

Identifying Selenium Stacks

Ramm Rectifier Co., Inc., Dept. MF, 527 Faile St., New York 59, N. Y.

Bulletin J. T. is a four-page, illustrated brochure which describes in detail how to identify selenium stacks. This brochure explains how to determine the electrical configuration of a selenium stack in an existing rectifier by examining the mechanical construction; i.e. three phase half wave or three phase bridge or three phase full wave center tap.

Drawings are supplied which permit ordering of replacement selenium stacks by simply placing dimensions in appropriate spaces.

Abrasive Products

Carborundum Co., Dept. MF, P. O. Box 337, Niagara Falls, N. Y.

"Catalog of National Standard Abrasive Belts, Rolls, Sheets and Discs" lists standard coated abrasive products used throughout industry. All items listed in this standard catalog are maintained in stock at warehouses by electronic order processing and inventory control. A customer tool to help cut costs and expedite service through use of standard catalog items.

Graphite Centrifugal Pumps

National Carbon Co., Dept. MF, 270 Park Ave., New York 17, N. Y.

A four-page illustrated bulletin S-7253, describes Karbate impervious graphite type F centrifugal pumps. A cut-away drawing clearly illustrates the features of the new carbon-to-carbon rotary seal.

Pump characteristic curves based on clear water at 70°F. plot total head, brake horsepower, and net positive suction head against gallons per minute for the four pump sizes. A dimension sketch and table present all dimensions of the 20 available models of the motor-mounted pumps.

Automatic Polishers

Packer Machine Co., Dept. MF, 456 Center St., Meriden, Conn.

Complete specifications on 5 different types of automatic units are offered including information on work capacity, production rates, buff heads, wheels, head adjustment, stand adjustment, motors, controls, work tables and available accessories. Machines are of the rotary indexing, continuous rotary, horizontal conveyor and straight line conveyor type.

Barrel Plating Equipment

Udylite Corp., Dept. MF, 1651 E. Grand Blvd., Detroit 11, Mich.

Modern, multi-use barrel plating equipment is catalogued in a 16-page booklet. Major plating barrel specifications augment 38 photographs and recommendations for barrel assemblies, horizontal barrel units, loading stands, storage and transfer units and final rinse units. Automatic machines, centrifugal dryers, heating and cooling coils, tank linings and rectifiers are discussed.

Bias-Type Buffs

Divine Bros. Co., Dept. MF, 201 Seward Ave., Utica, N. Y.

A new catalog sheet, covering the complete line of "Red-D-Vent" bias-type buffs, includes sizes and specifications, as well as complete descriptive material on metal-center buffs featuring an internal steel safety binder ring.

Steam Cleaning-Phosphating

Kelite Corp., Dept. MF, 81 Industrial Road, Berkeley Heights, N. J.

A colorful, eight-page, fully illustrated "Special Report" describes the Mark IV combination steam cleaning-phosphating equipment. It provides complete specifications for both the gas fired and fireless models. Illustrated with step-by-step photographs, it delineates features, processes, operating procedures, cost tabulations, and results.

Transistor Gold Plating Motion Picture

Sel-Rex Corp., Dept. MF, 75 River Rd., Nutley 10, N. J.

A 16mm technicolor motion picture is concerned with an important step in the manufacture of transistors and other semi-conductor products — gold electroplating to improve function and reliability. Essentially a case history presentation, the motion picture visits the new plant of Platronics, Inc., Linden, N. J., considered to be the country's largest facility designed for electroplating electronic components.

The film, which runs approximately eight minutes, supplies detailed information on "pilot plant" trial runs, prior to production plating; special equipment required for optimum results and lowest reject rates; preplate calculations to assure consistent quality; and quality-control procedures initiated in the trial run, followed through to laboratory tests after plating.

A print is available free of charge to qualified organizations for showing at technical meetings, educational seminars, or any general gathering interested in precious metal plating of transistors and other electronic components.

Ultrasonic Degreasing

Phillips Mfg. Co., Inc., Dept. MF, 3475 W. Touhy Ave., Chicago 45, Ill.

An 8-page, illustrated catalog describes ultrasonic cleaning applications and equipment. Bulletin 23 explains in detail the descriptions and features of tank transducers and ultrasonic generators for use in large and small scale degreasing operations.

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Apr. 22: 22nd Annual New England Regional Meeting, A.E.S., Hotel Statler, Hartford, Conn.

Apr. 30-May 4: Spring Meeting, The Electrochemical Society, Claypool Hotel, Indianapolis, Ind.

May 2-4: 16th Purdue Industrial Waste Conference, Purdue Memorial Center, Purdue University, Lafayette, Ind.

May 5-6: Empire State Regional Annual Meeting, concurrent with Rochester Branch A.E.S. 50th Anniversary Celebration, Hotel Manger, Rochester, N. Y.

May 8-11: 1st International Industrial Finishes Exhibition, Earls Court, London S.W. 5, Eng.

May 27: Annual Banquet, Masters' Electro-Plating Association, Plaza Hotel, New York, N. Y.

June 10: Annual Ladies' Night Dinner Dance, Pittsburgh Branch A.E.S., Churchill Valley Country Club, Pittsburgh, Pa.

June 18-23: 48th Annual Convention, A.E.S., Boston Host Branch, Boston, Mass.

June 25-30: Annual Meeting, American Society for Testing Materials, Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

June 26-27: 5th Annual Conference on Vacuum Metallurgy, American Vacuum Society and New York University, Co-Sponsors, University Heights Campus of N.Y.U., New York City.

Sept. 5-8: 11th National Chemical Exposition, Chicago Amphitheater, Chicago, Ill.

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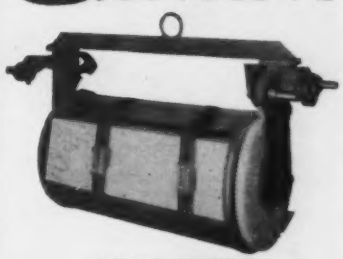

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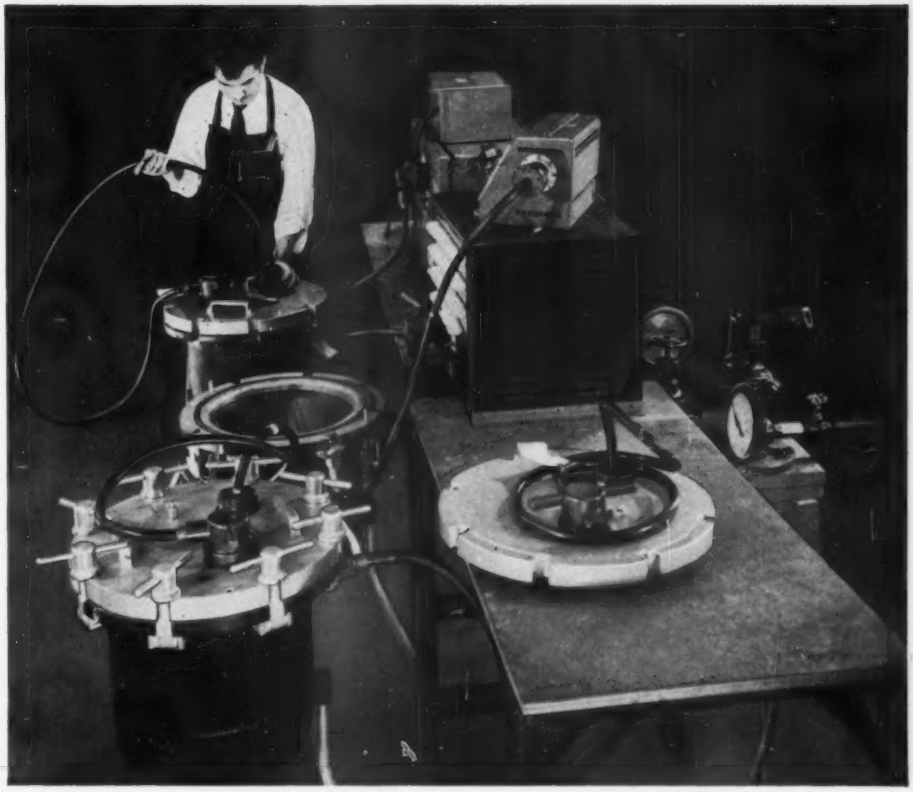

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